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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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Editor

Volume 101 NEW YORK, AUGUST 2, 1928 Number 5

Timely Action

THAT a storage dam of the New York water-supply system is weak enough to call for emergency safeguarding is disquieting news. The steps taken to protect it are surely not untimely. From the facts brought out by the statement of W. W. Brush, chief engineer, as printed on another page, it is plain that the structure is inherently too weak to be acceptable according to modern standards of dam construction—the more convincingly so because the masonry is relatively light and because infiltration of water under pressure is not a mere possibility but an established fact. The situation is made worse by the "bulging" of the face masonry which is reported to have occurred years ago, for, while this is not necessarily to be interpreted as incipient crushing or shearing displacement of the structure, it denotes a most unsatisfactory lack of integrity of the stone-faced concrete mass. While the inadequate proportioning of the dam can be understood in view of the early date at which it was designed—sixty years ago general knowledge of the stability of dams was still rather immature—there is no such explanation for its continuance in service, even though it has borne its load for many decades. It may be true that the location is such as to minimize the chance of life or property damage; yet the effect of failure would be to shake confidence in the entire reservoir system, and should be guarded against at all hazards. Lowering the water level by cutting down the ancient spillway and discharge channel is a commendable first step in the present emergency. The suddenly discovered weakness of the Boyds Corners dam lends strength to the belief that all great dam systems, and for that matter all dams, deserve thorough scrutiny from time to time, in order that their complete safety may always be assured.

A Highway Hazard Survey

THE study of road conditions in relation to highway accidents is being taken up by the Connecticut highway department. Already having in its allied department of motor vehicles one of the best organizations of any state for counting, recording and analyzing motor-vehicle accidents, the state is stepping ahead with a plan to coordinate these records with road conditions and ascertain if possible what relations exist between the highway and the hazards that have been shown to exist. Briefly stated, all points on the state highway system outside of cities where two or more accidents occurred in 1927 will be surveyed and tested out to determine whether road conditions contributed to the mishaps and how they contributed, and what should be done to eliminate the hazard. This action is distinctly inspiring. It has been so widely and persistently advertised that statistics establish drivers' carelessness as the major cause of motor-vehicle mishaps that road engineers have been getting a little smug in their belief that they have no problem to solve in creating greater highway safety. Evidently the Connecticut highway commissioner does not intend to be charged with this sort of narrow complacency, perhaps because he was previously motor-vehicle commissioner himself and has a perspective of road and driving hazards removed from direct participation in construction and maintenance. We believe that Connecticut is by means of this survey taking a forward step in highway safety, and furthermore we prophesy that the survey will disclose many more accident-provoking conditions on its public roads than anyone could have anticipated. And Connecticut has better roads and better road maintenance than most states and has paid greater attention to highway safety than any but a few other states.

There Is a Way

A "DRIVE" is to be made by an automobile association to correct the evil of blinding headlamps—a matter which we have repeatedly agitated in these columns. It is even said that some state motor-vehicle commissioners are taking part in the movement and that new lamps and holding devices are to be planned. This is interesting news. But why an organized effort? No new invention or design is needed, no new legislation; nothing more, in fact, than enforcement of laws already existing. At present the lamp situation is in a state of wild chaos, and creates dangers and accidents, wholly through the neglectfulness of officials. Lamps so set that their beam goes out horizontally or even on an upward angle, lamps that shed glare almost equally over a wide area, including the sight-range of the approaching driver are extremely common; yet they are notoriously dangerous, unnecessary and against the law. It requires no drive to correct this evil, but merely penal prosecution of the offending driver and cancellation of the license of the vehicle. If the highway engineer devotes earnest study to the problem of making his roads safe, it is not too much to expect the motor-vehicle authorities to co-operate in keeping them safe. There is a way—and only one way—to correct the headlight evil, and that is by enforcing the law and barring the reckless glare-driver from the road.

Dr. Work's Successor

AN UNFORTUNATE tradition has long assigned the post of Secretary of the Interior in the national government to political patronage. Accordingly it is not surprising that the incumbent of the place vacated by Dr. Hubert Work is a man distinguished by service to party politics rather than by knowledge and experience in the domain of the Interior Department. Mr. West may prove to be able; yet in view of the short tenure of office ahead of him, barely eight months, his appointment is not promising of constructive results. It will take most of his time to learn the nature of the numerous complex functions of the department, and until this process of education has been completed no wise decisions on the policies of the bureau can be looked for. The redeeming feature of the case is that it directs atten-

tion to the evil of the political tradition surrounding this particular Cabinet post. Since all such established traditions come to an end some time, it is likely that a future President, perhaps the incoming one, will recognize its unwisdom and initiate the practice of filling the Interior position on the basis of fitness. Unless this be done the movement to centralize all public work in the Interior Department is of questionable merit.

Bypass and Through Routes

AN INTERESTING change of sentiment is coming about in the matter of routing main highways through towns. Some years ago the layout of highway systems was seriously complicated by the insistent demand of small communities that trunk roads be run through their main streets. Highway engineers, who recognized the error of such location, argued strongly in favor of passing the roads around rather than through towns. But the pressure of the local demand, coupled with the fact that in a great many cases the existing highway locations were controlling and the towns along their course could not be avoided, made through-the-town locations almost universal. Now, having learned by experience that traffic is not an unmixed blessing, many towns are coming to see the undesirability of having arterial roads use their main streets. More and more often complaints are heard from town authorities about the clog of traffic and the cost of signaling and policing at their four-corners. It has become a sore question with them how to keep local business moving when there is a dense stream of long-distance traffic flowing through the local business district, and how to pay for the expensive traffic lights and police supervision. Accordingly we may live to see much activity in constructing bypass roads. The work is likely to bring some new problems, especially since experience has shown how rapidly settlement develops along a main highway even when it passes well clear of a town. But it is a distinct gain to have the small town realize the unwisdom of trying to put double service—street and through-road service—on a single thoroughfare. The future handling of highway problems will be materially facilitated by this reformation of sentiment.

Preserving Niagara Falls

MANY divergent views have been expressed on the preservation of Niagara Falls and the amount of water that may be diverted for power purposes. Some of these views came to the front at the recent meeting of the American Society of Civil Engineers in Buffalo. But the most important part of the discussion there was the first official publication of the Special International Niagara Board's interim report. The board recommended the immediate undertaking of certain remedial measures in order to divert water from the center to the flanks of the Horseshoe Falls and to the American Falls, but it failed to express itself on whether more water may be diverted for power purposes without harm, after the remedial measures have been taken. This latter question ought to be answered squarely in the board's final report, since it is an inseparable part of the subject for whose study the board was instituted. The beauty of the Falls is at issue only because water is being drawn for power development and because it is desirable to draw still more if it can be done without injuring the impressiveness of the great natural spectacle. The day is past when many people will agree with the view expressed by Lord Kelvin that the Falls should be laid bare to provide the maximum amount of power, but on the other hand few will go to the other extreme of maintaining that the Falls should be left untouched even though they may be seriously injured by erosion and even though proper engineering measures will enable great amounts of power to be obtained without detracting from their beauty. It is only the extremists on either side who do not realize that the waters of Niagara have two distinct values, the esthetic and the power value. Somewhere between the two extreme views lies a point at which both purposes can be served without undue injury to either, and one of the greatest services the Special International Niagara Board could render would be to attempt to determine where that point lies.

Better Publications

INTERESTING proposals for broadening the usefulness of the publications of the American Society of Civil Engineers were approved by its board of direction at the Buffalo meeting. The central proposal was for adding to the well known *Proceedings* and *Transactions* a third type of publication—namely, separate reports on individual subjects of importance, each report to be confined to a single subject. These reports are to emanate from the technical divisions. Such amplification of the society's printed production should make a significant change in its publications history and, we believe, will distinctly increase its service to the membership.

At present, under the plan of publishing current papers and discussions in monthly pamphlets of *Proceedings* and of massing the year's papers and discussions in an annual volume of *Transactions*, the literature of any special field of engineering is so thoroughly scattered that much of it is lost to general usefulness. The specialist engineer has no means of collecting those papers which bear on his field, except through the process of amassing a bulky collection of annual volumes—a small library, requiring an elaborate index to make its contents accessible. The new type of technical report will enable him to assemble in one group most of those papers and discussions which deal with the same subject, without dilution by a great mass of material not relevant to that subject. It will give increased distinction and use to the society's many fundamental contributions to the art of engineering.

The project has a close relation to the growing place of the technical divisions in the society's working scheme. It is altogether possible that the divisions eventually will be the principal agencies of technical work within the society, and through this evolution the present plan of leaving the choice of subject to members having an urge to write will largely give way to one in which papers will be written on subjects selected by the executive committees of the various divisions according to a definite plan. Such papers, with their discussion, are likely to add decisively to the thoroughness and breadth of engineering thought as developed by the society's work.

A proposed modification of procedure in the divisions which also was approved by the board should strengthen this influence toward thoroughness. Reports coming from divisions, comprising formal papers together with condensed discussions, are not to be published until they cover their subjects completely in the opinion of the board of direction. This plan, which is somewhat like that followed by the American Railway Engineering As-

sociation in handling its committee reports, will counteract the tendency to dispose of a subject hastily and leave it incompletely considered. It will lead to the practice of continuing the discussion of an important subject throughout a number of meetings, and thus protect against the often hampering limitations of available time at a meeting, as well as give leisure for development of views and criticisms.

The changes adopted thus present important possibilities for directing the society's work for efficiency in specialized channels. They promise so clearly to expand the usefulness of the society that they invite general support.

Safety in Construction—Shall It Be by Code?

IN THE TASK of creating codes of safe practices in construction which was intrusted to it three weeks ago by the conference of safety engineers in New York City, the American Engineering Standards Committee has need of its best thought if its accomplishment is to be inspiring and constructive. Contractors do not believe that fixed codes are desirable. They consider that other means of promoting safety are more efficacious and point to the fact that they have inaugurated them in recent practice with outstanding success. Their objections and assertions command serious consideration.

Contractors in the end are the ones who will apply the codes. Unless they do this willingly the codes to have any force must be converted into statute or mandate. Indeed, this is the great danger which contractors see in code creating. It has to be avoided if possible. There is, then, first of all the duty before the Engineering Standards Committee of formulating code restrictions and directions so reasonable that contractors will respect them.

To do this will require the liberal help of all construction interests. That it may be expected there is no doubt. Almost immediately following the decision of the conference, the Associated General Contractors, whose delegates had fought the instructions to proceed with code work, announced that it would lend its aid. This action gives high promise of an agreement on a code form deserving of acceptance.

It will be wise, also, to look back at the history of the construction safety code movement. A national construction safety code is not a recent idea. Eight years ago the Engineering Standards Committee began compiling a code sponsored by the National Safety Council. Several successive drafts were prepared and advanced for adoption, but difficulties developed, centering around opposition by the Associated General Contractors, which in 1926 brought about a virtual deadlock. The contractors then asked for a year's delay in code activities with the understanding that in this period they would conduct an aggressive educational campaign and then would take up code matters again. At the end of the year the association requested that the undertaking be abandoned, and the work drifted until this year, when the conference previously mentioned was called by the Engineering Standards Committee at the request of the association of governmental labor officials of the United States and Canada. The National Safety Council, however, withdrew as sponsor. The subsequent action of the conference has been indicated.

This brief review of code development to date is important to a clear understanding of the position taken by the contractors in the recent construction safety conference, a position based on clear convictions as to code dangers. There should be no misunderstanding of the facts. Whether individually or as represented by their associations, contractors are not combating accident prevention; they are opposing any fixed code of accident-prevention requirements which may be and most certainly will be crystallized into statutes and mandates carrying punitive powers. They advocate instead the promotion of safety by educational methods. They believe that safety is not an engineering problem and cannot be created by legislation but is the result of giving men the safety instinct by co-operative, voluntary educational effort. Indeed, they point out that voluntary educational campaigns to reduce accidents in construction are at the present time well under way throughout the country, not only in the Associated General Contractors organization but in the National Association of Builders Exchanges, the New York Building Congress and many other organizations. The result is that an active accident-prevention movement among contractors is in progress.

The facts as related merit attention. It is feared by contractors that their work, which they consider fundamental, will largely fall with the adoption of mandatory safety codes. They fear again that legislation will follow which will put politics in construction and in many cases give political officeholders discretionary powers which will constitute a vicious situation in and work a hardship on construction.

If, then, the safety code work now in hand is to gain the confidence of contractors, it has to be premised on a conception quite different from that of mandate or compulsion. The code must eliminate "thou shall" and "thou shalt not" from its thought and word. This attitude of mind will not perhaps impress state labor commissions and casualty insurance interests, but it is the engineering attitude and should be maintained in all the code work. This will be true whether or not all the fears of law and mandate expressed by contractors are justified. Indeed, it is evident that some of these fears are far-fetched.

It is quite plain too that, whatever may be accomplished by organizations of highly responsible contractors through educational inspiration, there will be contractors who will respond only to mandate and punishment. Accordingly contractors also will find it needful to give consideration to the other side of the construction safety question. Let it be remembered that despite their present awakening to accident prevention, and despite the mounting toll of accidents in construction, contractors have been most tardy in devising and employing safety measures. Their work even today is turning largely to safeguarding their own property and workmen, and they have not hitherto recognized actively their responsibility for conserving the safety of the public. These facts have brought about public action, as could well have been foreseen.

The recent conference was dominated by labor commissioners and casualty insurance officials. It is the task of the Engineering Standards Committee to make sure that the further work is directed with full consideration of construction progress and not in any bureaucratic or business interest. We are confident that it is their intention to do this. Contractors can help their business most by working in and with the committee. Meanwhile their own very promising activities can go ahead to the advantage in all respects of safety in construction.

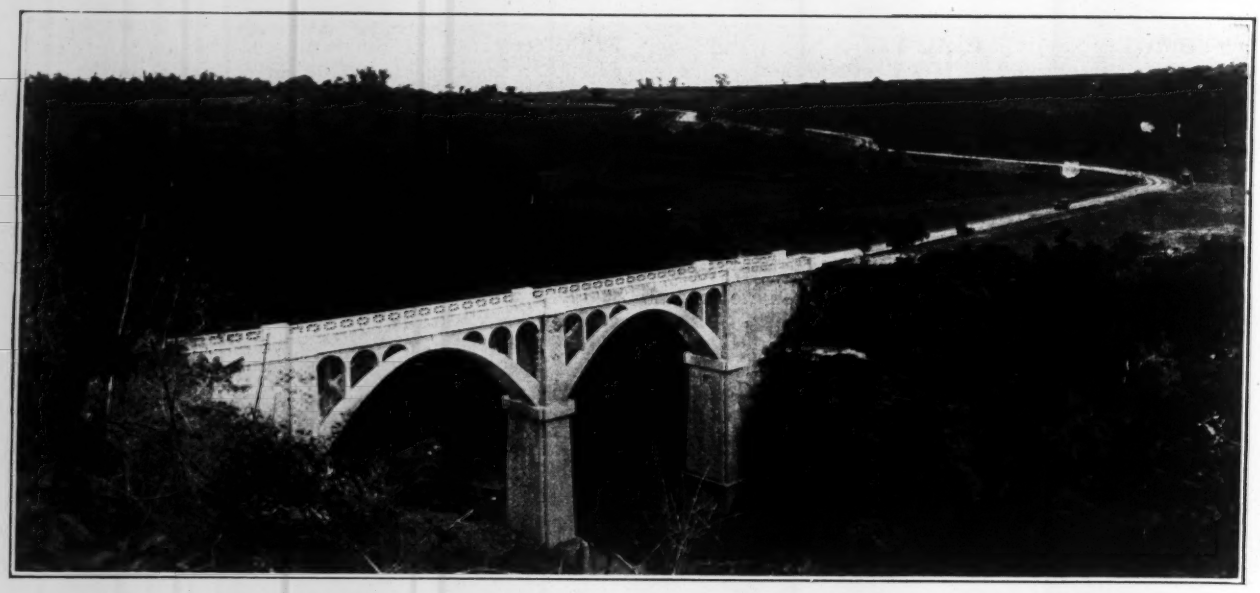


FIG. 1—A PORTION OF THE MANILA-SOUTH ROAD
The Sabang bridge shown is 100 ft. from the base of the cutstone piers to the road crown.

Philippine Highway Progress and Plans

More Than 7,000 Miles of Modern Roads Link Tribal Centers With Urban Civilization in America's Asiatic Outpost

By Marcial Kasilag
Chief Construction Engineer, Bureau of Public Works, Manila, P. I.

MORE than 7,000 miles of first, second and third-class roads are now built and in use in the Philippine Islands. The government's bureau of public works was organized in 1905, and a comprehensive road system has been worked out by bureau engineers and is being pushed to completion as fast as funds permit under bureau supervision. "The policy of road building in the Philippines," says A. D. Williams, director of public works, "is to maintain those routes of communication already established and to extend others until every section of the country with justifiable productive traffic is supplied with an outlet for its products."

The results of Philippine road building are far more modern than the means. Labor is cheap and it has been found more profitable in the past to excavate and grade with tools sometimes more primitive than pick and shovel. Crushed coral is used in many cases for surfacing, and embankments are thatched with growing weed. But waterbound macadam is the type of construction most extensively used for country roads, and with it the use of modern road machinery is gradually finding its way into Philippine construction. It has been demonstrated that the final cost is lowered in spite of the fact that common labor may be had as cheaply at 40c. a day.

Under the Spanish Regime—Early road work consisted of opening routes of communication throughout the islands in a thorough manner, leaving to the present government a valuable asset in rights of way incorporated in the laws of the land and remaining a part of the public domain. Public works in Spanish times were largely under the control of local municipal officials, and the bureau of public works at Manila acted only in an advisory capacity on request. The municipal president, assisted by deputies, was in charge of all work, and the collection of taxes in his municipality, subject to the inspection of the local priest, was done under the same office. In the case of the road tax this consisted principally of fifteen days of compulsory labor, required each year of every able-bodied male citizen, in lieu of money. The provincial governor, assisted by an engineer, supervised in a general way all public works in the various municipalities, and important projects, usually heavy masonry or steel bridges, were built by contract and financed with insular funds. With such provisions the Philippines had naturally the poorest kind of rural roads.

Two types of highway were laid under Spanish administration. One had a pavement of cut stone, usually of adobe quality. The size of stone generally used was about 8x20 in. This made a smooth pavement, but it wore very rapidly under ordinary traffic conditions. Cobblestone pavement also was used, and this was more durable, but naturally rougher. Boulders varying in size from 4 to 9 in. were taken from river beds and hauled to the scene of operations.

The American Way—The present road-building policy consists primarily of constructing first-class metaled roads, maintaining existing second-class and third-class roads until they can be reached by first-class construction, and maintaining and opening trails for carts and pack animals for communication with the isolated and mountainous regions which abound in the Philippines. In pursuance of this policy the 49 provinces composing the

Philippines, with the exception of the small isolated province of Batanes, have been organized into engineering districts under the immediate technical supervision of the central office in Manila. Each district is in charge of a district engineer, who is provided with a number of technical assistants. The capital of each province has thus become the center of development of provincial systems of highways which in conformity with the general plan, are being rapidly connected by interprovincial roads.

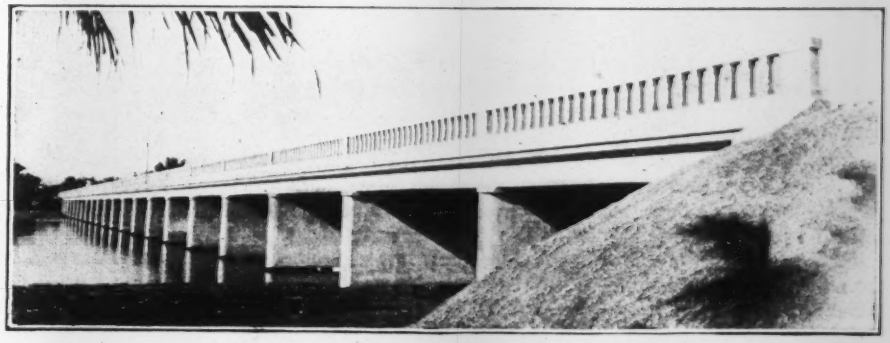


FIG. 3—CONCRETE GIRDER BRIDGE ON THE MANILA-NORTH ROAD

The extension and building of trunk highways is the most important part of the work now under way. Connecting links are now being forged in a great north-to-south highway, Fig. 2, from the very northernmost part of the island of Luzon to the southern tip of Mindanao, a distance approximating 1,100 miles as the crow flies. When this is complete motor traffic will be able to traverse the Islands in a direct north-south route for the first time in history, with only two ferry points in the whole distance.

On the island of Luzon, which has an area of 47,238 square miles and a population of 6,084,610, a trunk road is being extended north and south of Manila, Figs. 1 and 3, which, when completed, will have a total length of 817.76 miles. Of this total mileage 608.35 miles are of first-class construction, 68.97 miles are second-class, and 6.83 are third-class, with 133.6 miles under construction through picturesque, undeveloped mountain regions between the provinces of Tayabas and Camarines Norte and Camarines Sur.

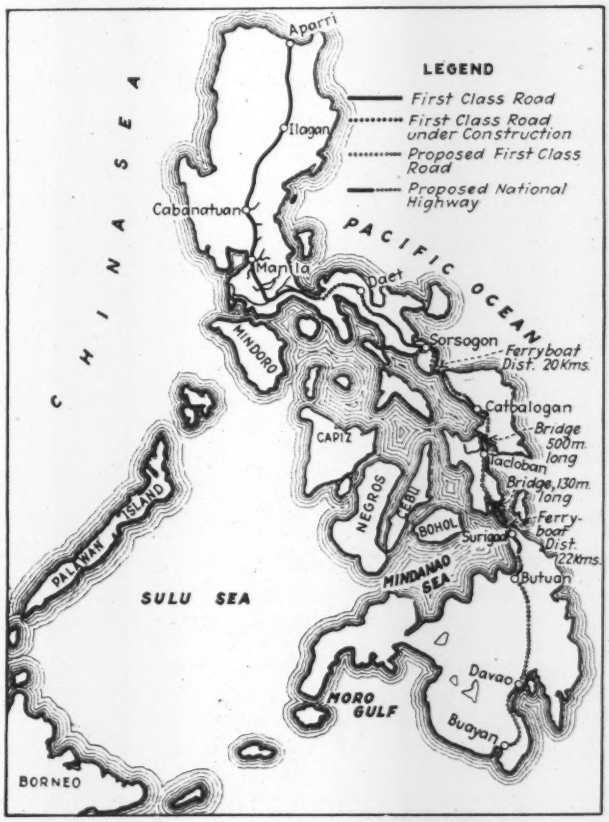


FIG. 2—PHILIPPINE ROAD SYSTEM SHOWING NATIONAL HIGHWAY

The length of the national highway is 1,029 miles, of which 614 miles are completed, 196 miles are under construction, and 219 miles are projected.

Secondary Trunk Roads—Two secondary trunk roads are also nearing completion north of the city of Manila. They are known as the Manila-Tarlac road and the Cagayan Valley road. The first branches off from the main Manila-north road at the town of Quinga, province of Bulacan, 28.47 miles from Manila, traverses the provinces of Pampanga and Tarlac, and joins again with the Manila-north road in the province of Pangasinan at the Agno River bridge. This route makes the distance from Manila to the bridge shorter by 7.46 miles.

The Cagayan Valley road, Fig. 4, branches off from the Manila-north road in the province of Neuva Ecija and goes through the great Cagayan Valley, famous for its tobacco production. This valley, lying between two ranges of mountains, the Sierra Madre on the Pacific Coast and the Cordillera Central running north and south in the middle of Luzon, includes three provinces and is large enough to accommodate with its potential wealth a population of 5,000,000 people. The present population is 429,620. This road was started 11 years ago, excepting the short sections north and south of the capital of each province, which had been previously undertaken with local funds. The road runs through to Aparri, the northernmost town in the Philippine Islands, 360.72 miles north of the city of Manila. Much of the road is of first- and second-class construction, the remainder is third-class according to the classification which follows.

The northern terminal of the Manila-north road is in the town of Banqui, province of Ilocos Norte, 371.6 miles from Manila. These two terminals are being connected by another road now under construction along the north coast of the island of Luzon. The distance between them is 89.17 miles.

These details and distances give an idea of the network of fine highways on the largest of the islands. The native Filipinos, members of the more or less wild tribes in the mountain provinces, readily appreciate the advantages of road communication. They, themselves, make fine road workers, and it has happened repeatedly that some native chieftain would lead a delegation to Manila to plead for more roads. The advantages of bus transportation, which is well developed in the islands, have made them see more clearly than anything else the need for good highways.

Definitions for Classification—Mention has been made

of first-class, second-class and third-class roads in the Philippines. These are defined as follows:

First-class roads are well graded and surfaced, thoroughly drained, and constantly maintained; the bridges and culverts are usually complete and permanent. Where bridges are missing, ferries capable of carrying automobiles weighing two tons or more take their places. These roads are continuously passable at all times, with possible exceptions in typhoon seasons. The width of right-of-way is universally 49.2 ft., of roadway 22.97 ft., and of metaling 16.405 ft. Cross-sections and details are shown by Figs. 5 and 6.

Second-class roads are fairly graded, partially surfaced, and intermittently maintained; bridges and culverts are usually complete but, in part, are temporary structures. These roads are continuously passable for vehicle traffic during the dry season, and more or less passable in rainy seasons.

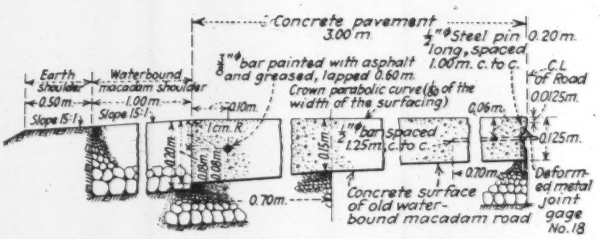


FIG. 5—STANDARD CONCRETE ON OLD MACADAM

FIG. 4—SWITCHBACK ON THE CAGAYAN VALLEY ROAD

Third-class roads are all the traffic routes for carts not included in the first and second classifications; such roads are usually narrow, poorly graded, or not graded at all, and are generally impassable in the rainy season.

In accordance with this classification there were in existence, on Dec. 31, 1927, the following lengths of roads:

	Miles
First-class	3,749.5
Second-class	1,884.0
Third-class	1,443.4
Total	7,076.9

Exclusive of the above mileage, there are 3,032.43 miles of mountain trails for pack-animal traffic and for communication with isolated and mountainous regions.

The construction of these roads involved the building of 4,653 reinforced concrete bridges, aggregating 19,664 meters in span, in addition to those already built by the Spaniards.

Financing Philippine Highways—Funds for road and bridge work in the Philippines have been provided by five separate sources in the past, and probably will continue to be in the future. These include provincial funds accruing from the double cedula or poll tax of two pesos a year, or $1 in United States currency, of which one peso is set aside for road and bridge funds; a percentage of the internal revenue and land taxes collected in the provinces, aggregating about 4,580,000 pesos annually; the motor vehicle law provision, which nets a revenue of about 1,200,000 pesos a year from motor vehicle licensing and the licensing of operators; the gasoline tax, which yields about 2,500,000 pesos a year; and insular aid from the Philippine legislature, varying from year to year. This year the insular aid amounts to 2,716,000 pesos. From all these sources money for road construction and maintenance amounted in 1927 to 15,984,658.55 pesos. The sale of bonds is also resorted to in financing important permanent bridges and durable pavements. In the last year, the total amount of road and bridge bonds sold aggregated 3,562,000 pesos, bringing the available 1927 road fund total to 19,546,658.55 pesos.

Maintenance—All first-class roads in the Philippines are maintained under what is known as the isolated *caminero* (cantonnier) system. Each kilometer of road is assigned to a *caminero*, who is furnished with what is, for him, a very complete set of tools—a wheelbarrow, a shovel, a pick-mattock, a rake, an iron tamp, a grass hook and a hand sprinkler. Within each kilometer there are five to ten earth depositories or bins containing fine gravel or rock screenings for maintenance material. The *caminero's* duty is to keep the road in as nearly as possible the

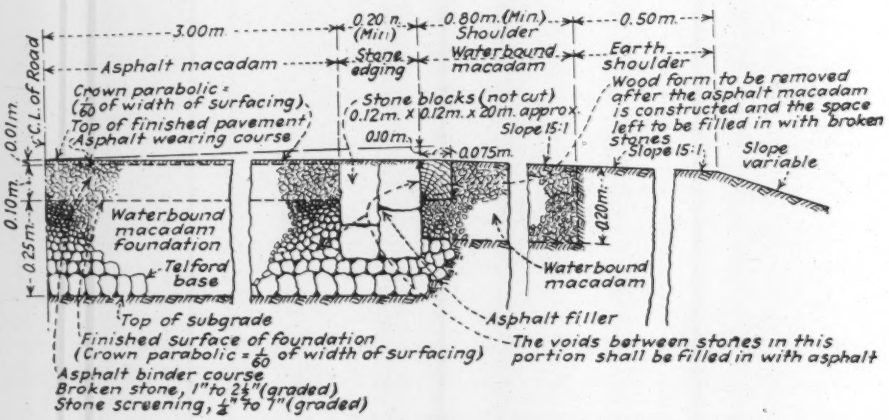

3.00 m.
0.20 m. (Min.)
0.80 m. (Min.) Shoulder
0.50 m.
Asphalt macadam
Stone edging
Waterbound macadam
Earth shoulder
C.L. of Road
0.01 m.
Crown parabolic = 1/60 of width of surfacing)
Top of finished pavement
Asphalt wearing course
Stone blocks (not cut)
0.12 m. x 0.12 m. x 20 m. approx.
Slope 15:1
Wood form to be removed after the asphalt macadam is constructed and the space left to be filled in with broken stones
0.10 m.
0.075 m.
Slope 15:1
Slope variable
0.10 m.
0.25 m.
Waterbound macadam Foundation
Telford base
0.20 m.
Waterbound macadam
Asphalt filler
Top of subgrade
Finished surface of foundation (Crown parabolic = 1/60 of width of surfacing)
The voids between stones in this portion shall be filled in with asphalt
Asphalt binder course
Broken stone, 1" to 2½" (graded)
Stone screening, ¼" to 1" (graded)

FIG. 6—STANDARD BITUMINOUS MACADAM ROAD

same condition as it was originally turned over to him after construction by immediately repairing all holes developing on the surface, removing all animal droppings, cutting the grass growing on the shoulders and slopes, and trimming the trees planted alongside.

Ten *camineros* work what is called one section and each section is put in charge of a *capataz*, or sub-foreman, who is furnished with a bicycle for his transportation. Ten or more sections make a division, and each division is under the immediate supervision of a maintenance foreman. He is given a motorcycle for his transportation. All of these men, including the *camineros*, are paid by the month. The *camineros* wear uniforms which usually include a pair of brilliant red trousers, adding to the picturesqueness of the Philippine wayside.

Second-class and third-class roads and trails are only generally and intermittently maintained by a gang of men under a *capataz*, and this organization is discharged as soon as the work required is finished.

In this connection it is interesting to note that the bulk of freight hauling in rural and suburban districts of the Philippines, which up to a few years ago was the exclusive province of bull-carts and water buffalo or carabao, is now being handled largely by motor trucks and buses. In all localities with improved roads there are invariably two or three motor truck transportation lines competing with one another in transporting passengers and freight. They offer serious competition to the railroads where their routes are parallel.

A New Type of Paving—The cost of maintaining ordinary water-bound macadam roads has increased rapidly in the last few years with the added burden of modernized traffic. It has increased so rapidly, in fact, that the bureau of public works has decided to use a more durable type of road pavement. The accompanying designs, Figs. 5 and 6, for a concrete and an asphalt pavement to be placed on top of the existing macadam roads show the standards of construction. Up to 1916, the average cost of maintaining water-bound macadam roads was about 500 pesos per kilometer. In the last five years it has jumped up to about 830 pesos, on the average. In the province of Leyte, where traffic is exceptionally heavy, the higher cost is almost entirely attributable to the destructive effect of heavy truck traffic and the same is more or less true of other provinces. In Leyte the maintenance cost of the last five years has averaged 1,675 pesos a kilometer. Motor traffic is growing fast. Registered motor vehicles totaled 6.000 in 1916, as compared with 27,597 in 1927.

The bureau of public works had constructed, up to the end of 1927, 2.36 miles of this new type of concrete road and 17.4 miles of asphalt road. Just recently a contract was awarded in the province of Pampanga for the construction of 16 miles of concrete pavement 19.7 ft. wide at a total cost of 699,655.50 pesos.

The Future Policy—It is now the policy of the Philippine government to pave with asphalt or concrete all existing modern roads subjected to heavy traffic as rapidly as funds will permit. The policy was put into actual practice the first of this year with the asphalting of sections of main roads through towns and other large centers of population, usually one kilometer on each side of the plaza or center of the town. This work costs on the average of 1.8 to 2 pesos per square meter of pavement if the penetration method, which is required where the traffic is very heavy, is used; and 45 to 60 centavos per square meter if the surface painting method, which is permissible in light-traffic regions, is applied.

Solving a Common Problem in Engineering Economy

Analysis of Three Methods Giving the Same Result but Differing in Probability of Proper Interpretation

By Eugene L. Grant
Associate Professor of Civil Engineering, Montana State College

A RECURRENT problem in engineering economy involves the question, Can we afford to make a present investment to save a future expense? This frequently occurs as a choice between two (or more) ways of doing the same thing, one of which requires a higher initial investment but involves a lower annual cost of operation.

Such a problem requires some method of reducing investment cost and annual operating expense to a common base. There are three current methods of solution for such a problem. These may be called (1) the method of per cent annual return on extra investment; (2) the method of comparative annual cost, including interest; and (3) the method of capitalized cost. Properly interpreted, there is no difference in the results obtainable by the three methods; but there is considerable difference in the probability of the three methods being properly interpreted. Let us consider a highly simplified illustration.

The Problem—Sam Jones owns a tract of land adjacent to a stream and plans to build structures to irrigate it. He may install either a gravity system with a diversion dam and a comparatively long diversion canal, or he may build a pumping plant to pump water directly from the stream. He estimates his costs as follows:

	Pumping	Gravity
First cost	$9,000	$21,000
Operation and maintenance	$1,200	$300
Annual depreciation, per cent	5	1
Annual taxes, per cent	1	1

As an alternative to investing the extra $12,000 in the irrigation project, he might invest it fairly conservatively elsewhere at a net income of about 6 per cent.

Per Cent Annual Return on Extra Investment—The additional investment in the gravity plant is $12,000. The problem is whether the annual saving from the gravity plant justifies that increased investment. If the saving represents enough more than the 6 per cent return Jones could get elsewhere, presumably it is worth while for him to build the gravity works. The problem might be set up as follows:

Annual Costs	Gravity	Pumping
Operation and maintenance	$300	$1,200
Depreciation	210	450
Taxes	210	90
Total	$720	$1,740

The annual saving from adopting the gravity plant is $1,020. This represents 8.5 per cent return on the extra $12,000 investment in the gravity plant. It is 2.5 per cent more than Jones could obtain elsewhere. If he considers this sufficient additional return to compensate for the extra risk and uncertainty involved, he will build the gravity plant.

Comparative Annual Cost, Including Interest on Investment—Jones could obtain 6 per cent interest elsewhere. Therefore he is giving up that money return by investing his funds in the irrigation plant. In the sense of economic sacrifice, the interest which he is losing might

be considered as much a cost of the irrigation works as if he borrowed the money and had to pay 6 per cent interest on it. With this assumption the cost comparison will be as follows:

Annual Costs	Gravity	Pumping
Operation and maintenance	$300	$1,200
Depreciation	210	450
Taxes	210	90
Interest	1,260	540
Total	$1,980	$2,280

This shows an annual saving of $300 from adapting the gravity plant.

Capitalized Cost—A sum of $1,000 invested at 6 per cent provides $60 annual income. Conversely, a $60 a year expense which goes on forever is the equivalent of having been forced to pay out $1,000 now. We may speak of $1,000 as the capitalized cost of a perpetual $60 a year expenses. If we compare the economy of two installations on the basis of capitalized cost, it is equivalent to finding out for each installation what present investment is necessary to provide for building the installation now, and for operation and maintenance and the necessary periodic replacements for the entire assumed period of service, in this case perpetual. For each installation, therefore, we add to the initial investment the capitalized cost of operation and maintenance and other annual expenses, and the capitalized cost of depreciation. Working out the problem in this way, the result is as follows:

Item	Gravity	Pumping
First cost	$21,000	$9,000
Capitalized cost of operation and maintenance	5,000	20,000
Capitalized cost of taxes	3,500	1,500
Capitalized cost of depreciation	3,500	7,500
Total	$33,000	$38,000

Relative Advantages of the Methods—A careful examination of the three solutions will show that their results are mutually convertible. The first solution gave a return of 8.5 per cent on the additional $12,000 investment. This is 2.5 per cent better than the 6 per cent rate which may be obtained elsewhere. But 2.5 per cent of $12,000 is $300, or the yearly saving obtained in the second solution. And 6 per cent of $5,000 (the saving in capitalized cost obtained in the third solution) is also $300, the annual saving from the second solution. It is clear, therefore, that all three methods of solution give the same result. The main factor to be considered in selecting a method should be the readiness with which it is possible properly to interpret the result of the calculations as a basis for administrative action.

The first method, in which the annual saving of one plan is expressed as a per cent return on the extra investment which it requires, usually gives the truest picture of the situation. Consider Jones' predicament in deciding which system to install after having made his calculations. The vital question which he must decide is whether or not he considers 8.5 per cent a satisfactory probable return on the extra $12,000 necessary for the gravity system considering the uncertainties of his estimates and the risk of loss due to a possibility of changing conditions.

It is likely that in this case good judgment would actually dictate that he put in the pumping system. But 8.5 per cent is hardly an attractive probable return for a speculative venture in any field, particularly for an agricultural venture where the profitableness of the enterprise as a whole is subject to wide fluctuations. The expression of the estimated saving as a rate of return on additional investment sets the problem squarely before the administrator.

The method of capitalized cost is particularly at fault in this respect. An apparent saving of $5,000 in capitalized cost might make Jones decide to put in the gravity system, whereas the interpretation of that figure in other terms would demonstrate to him that the gravity system was inadvisable. The greatest difficulty with using capitalized cost in economy studies is the great importance of the assumed interest rate in affecting the apparent result. For instance, capitalized cost figured on a 3 per cent basis would show a $22,000 advantage for the gravity plant; on a 9 per cent basis it would show a $667 advantage for the pumping plant.

Of course in any actual economy study there are always many judgment factors which cannot be expressed quantitatively but which nevertheless have an important effect on the final administrative decision as to what design should be selected. The arithmetic comparison of the economy of various designs is merely one of the factors to consider in arriving at the proper administrative decision. But this limitation on the mathematical approach to a problem in engineering economy is just one additional reason for trying to make the results of the mathematical calculations present the story in the best possible manner.

Alkali Land Reclamation Studies

Current studies and experiments on the reclamation of alkali land after drainage were summarized briefly in a committee report presented to the American Society of Agricultural Engineers at its Washington meeting in June. Considerable progress is being made in the understanding of this subject, though its size and complexity appear to be increasing. The importance of calcium salts in making possible the leaching out of the sodium salts which constitute the most destructive element of "alkali" is clearly recognized at present. At the same time, the worst forms of alkali land, especially where calcium materials are not in the soil or available near by, now are believed to be not worth reclaiming. On the Vale project in Oregon, and part of the Gem district in Idaho, all the badly alkaline land has been eliminated from the irrigated area on this account.

Experimental work on alkali reclamation is under way in Los Angeles, Calif.; at Banida and Caldwell in Idaho; at Vale and the State Agricultural College, Oregon; at Yuma, Ariz.; and in Utah. In all instances the lands under experiment had good drainage, which held the groundwater 6 to 10 ft. below the surface. In some of the experiments, an application of ½ to 1 ton of sulphur per acre, together with 15 to 20 tons of manure (or 1½ to 2 tons of gypsum) proved highly effective in converting sterile alkali land into land capable of growing a crop, after a treatment of a year or less. In the Imperial Valley it has been found that alkaline areas on which rice is grown are in better condition afterward than where a like amount of water is applied without growing rice.

In the Utah experiments, calcium chloride proved to be much more efficient than calcium sulphate. Experiments in unusually heavy alkaline soil in the Yuma Valley, using 1 ton calcium chloride plus 20 tons of manure per acre, are said to have removed 175 tons of salt per acre from the upper 6 ft. of soil.

Brass in Engineering: Failures and Remedies

Frequent Troubles at Minneapolis Water Filters Led to Extended Study Which Indicates Internal Stress and Corrosion as Major Causes—Remedies Tried and Conclusions

By W. N. Jones
Designing and Construction Engineer, Tampa, Fla.

PERPLEXING experiences with failure of brass and bronze filter equipment continued at Minneapolis for a long while in spite of various remedies tried. As a result of investigations and tests, internal stress was concluded to be the main cause of trouble. It may be relieved by annealing the metal or by removing the surface material by planing or turning. A change to Monel metal also eliminated the trouble, but at considerable expense, which might possibly be reduced by changes in design. Experiences of the same kind at other places are cited.
—Editor.

BRASS AND BRONZE of various kinds are used extensively in engineering structures, and especially in water-works plants, on account of their strength, cheapness, workability and resistance to corrosion by water or excessive atmospheric moisture. About 1913 failures began to occur at different cities without apparent reason. The writer at that time was engineer in charge of the municipal water filtration plant at Minneapolis, Minn. While the following information relates specially to the strainers of filter plants it may apply also to brass for pumps and other equipment.

Early Experience at Minneapolis—In 1912, the city let a contract for the strainer system of its filter plant, including brass wire-cloth and bronze strainer plates, bolts, nuts, washers and fastening bars. The strainer plates were to be of No. 16 B.W.G. and to have $\frac{1}{16}$-in. holes punched before the plates were bent to shape. The general design of the strainer system is shown in Fig. 1. No inspection or tests during manufacture were ordered, reliance being placed on the maker. The workmanship was good and the material appeared to be satisfactory. Six filter units were put in operation in 1913. After about 30 days, unusual agitation in washing the filters was found to be due to breaking of the center plates longitudinally through their centers. At first this was attributed to flaws in the metal, but as breakages of bolts and plates occurred almost daily it was decided to replace the entire installation and to reinforce each new center plate with a $\frac{1}{8}$-in. brass strip $\frac{3}{4}$ to 1 in. wide, riveted along the axis. These plates stood up longer, but failures occurred at one or other side of the brass strip.

Several of the side plates failed by transverse cracks, which was thought to be due to concentration of external stresses at the reduced cross-section at bolt holes. Investigation indicated that internal stresses set up by cold working of the metal and subsequent corrosion were large factors. Tensile, bending and shearing tests seemed to show that the material was of good quality.

As the failures appeared to be due to the design, the city made entirely new plans and specified Tobin bronze. As shown by Fig. 2, the plates were thickened to No. 14 B.W.G., were reinforced by bronze ribs at each anchor bolt, and the holes were made $\frac{3}{32}$ in. instead of $\frac{1}{16}$ in. in diameter in order to reduce the friction of the water. Larger bolts were also used. The plates were to have a tensile strength of at least 62,000 lb., with an elongation of 25 per cent in 8 in. and an elastic limit at least half the ultimate tensile strength. This metal was to bend flat at 180 deg. without fracture on the outside of the bend. On request of the manufacturer, the ribs and hook bolts were allowed to be either cast or rolled and to have a minimum tensile strength of 42,000 lb. The material inspected and tested at the factory by an independent testing firm was found to meet the specifications; the average tensile strength was 62,000 lb. for the plates, 69,000 lb. for the rods and 49,000 lb. for the bolts.

One filter tank was equipped with the new material and wash-water was turned on before placing the gravel. Immediately excessive agitation occurred and several

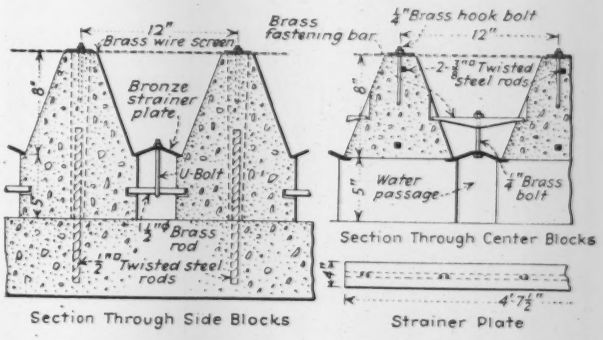


FIG. 1—STRAINER SYSTEM; ORIGINAL DESIGN

anchor bolts were found broken. With new bolts applied and everything tight and solid the gravel and sand were placed, but after about ten days' operation it was found that many plates were cracked and bolts broken. The nature of the cracks indicated that the bolts had failed first, concentrating pressure on the plates where the bolts still held. As the breaks in the bolts seemed to indicate flaws, new bolts tested to 800-lb. loads were installed with the new plates.

Experiments Tried—Sample bolts were tested in a testing machine until the hooks straightened out, requiring loads of 1,350 to 1,420 lb. Others were bent flat on themselves without showing fracture, and those tested to destruction gave an ultimate tensile strength of 71,000 to 100,000 lb. Some were given a microscopic examination and others the mercuric-chloride test. All tests showed the material to be exceptionally good. To see if the wash-water pressure below the plates might account for the failures, holes were drilled through the filter wall and fitted with pressure gages. But these never showed more than 7½ lb., equivalent to 270 lb. on each anchor bolt, which was far below the test loads.

Since external stress seemed to have no bearing upon the failures, it was believed they might be due to internal stresses set up during manufacture. To relieve any such stresses, a number of bolts were heated to a cherry red in an open furnace, some being cooled in air and others being dropped into lukewarm water. Each bolt was then tested to a 600-lb. load, which was all they would stand without starting to straighten. With these bolts matters improved for awhile, but after about four weeks several plates were blown entirely off their seats by the wash water.

Examination showed the same old trouble. Anchor bolts had failed and some plates showed signs of failure, with cracks in every direction like the checking of timber under a hot sun. Failure seemed to start on the convex side of the plate and radially from the bolt holes, though no radial cracks were found at the strainer holes, due probably to the fact that the latter holes were drilled, whereas the former were punched. Samples were sent to the testing laboratory and to the manufacturer, but no reason for the failures was discovered.

Temperature and Electric Factors—Temperature changes were next considered as a possible cause of failure. Bolts were placed on ice in an ice box and then warmed, this process being repeated several times for a number of days. A complete row of plates and bolts was also set up in the open air and left for eight weeks. Other bolts were placed in the open air under 800-lb. loads. Still others were subjected to the mercuric-chloride test. But none of these tests developed weakness or failure. Other tests were made to determine

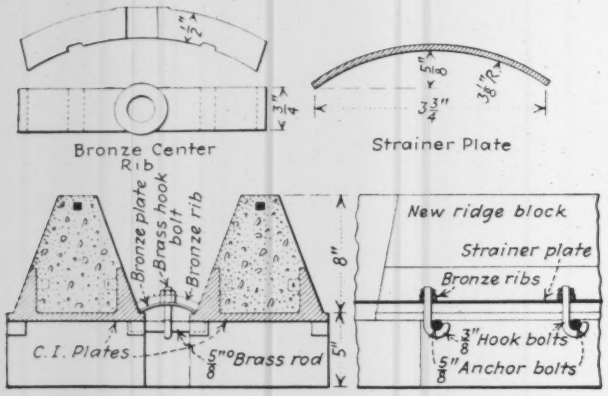


FIG. 2—STRENGTHENED STRAINER CONSTRUCTION

whether stray currents from the operating motors might have set up electrolysis, but no such conditions could be found.

The manufacturers suggested that cold working of the metal might have caused crystallization which might be overcome by annealing. A set of bolts and plates was therefore sent to them for treatment, but when this material was returned to Minneapolis, many of the plates were found cracked and most of them were bent or out of wind. All showed evidence of having been greatly overheated. Although the manufacturers refused to describe the treatment given, it was ascertained that after annealing, the plates had been reformed in the dies and some had been hammered by hand to overcome the deformation due to annealing.

Design Changed for New Filters—In designing four additional filter units, in 1914, a number of small wash-water pipes were substituted for the larger pipes of the older filters in order to reduce the impact on the center strainer plates and to distribute the pressure more equally. As this design, Fig. 3, was made before receiving any of the re-designed plates and bolts for the old filter (which were expected to eliminate all troubles), the same general design was followed, but with die-pressed anchor bolts instead of hook bolts. To prevent external strains being set up in the plates by screwing the nuts too tight, cast-iron shoulders were placed on the lower part of the ridge blocks, with machined surfaces to receive the lower edges of the plates. Bronze die-cast

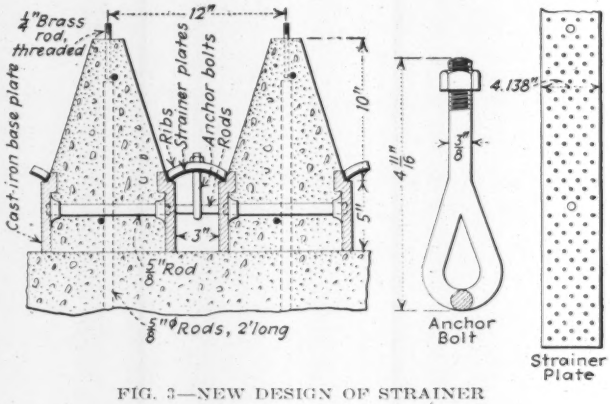


FIG. 3—NEW DESIGN OF STRAINER

ribs were bored to receive the bolts and ground to fit the plates. Thus the ribs would take all stresses due to tightening the nuts and would help to carry the wash-water pressure. The only load carried by the plates without assistance would be that due to the sand and gravel filling and that caused by the friction of water passing through the strainers and filling.

Reports by the testing laboratory showed the material to be as specified. But a filter unit equipped with it and operated at maximum rate for six weeks showed many of the plates cracked and checked. Most of the cracks did not extend through the plates and were on the convex side, as in the second lot of plates for the old filter. This condition again indicated that the failures were not due to external stress but to some cause within the plates, aggravated by external conditions of some kind. Die-pressed anchor bolts were fractured at the base of the thread, just below the nut. Ribs were cracked either entirely across or on one side only, but always at the bolt holes. The fractures showed dark, as in the old bolts, which seemed to indicate stresses set up by temperature changes, followed by corrosion due to some element in the air or water.

A complete strainer set was then erected in the open air and left exposed for nine months, the temperature ranging from bright hot summer sun to 30 deg. below zero. Close examination disclosed no defects or signs of failure. This set was then assembled in the coagulating basin, and left for 75 days under 9 ft. of water, the basin being in operation and the temperature of water ranging from 37 to 60 deg. F. In these two cases, the changes from actual filter use were the absence of sand and gravel fill, of water filtering and of filter washing. Two out of three plates were cracked and checked like those tested in the filter, thus disposing of the idea that failure was due to temperature stresses or the reversal of stresses set up by alternate filtering and washing. All the bolts were sound and in the testing machine they showed the same strength as when new.

During this experimental period, further tests were made on the material. Pieces cut from new stock proved satisfactory in tensile strength and cross bending, but pieces from plates that had failed would crack or fracture when bent to 90 deg. While the elastic limit could not be determined, it apparently corresponded closely with the ultimate strength, although the writer's understanding is that in bronze it should be about half of the ultimate strength. There appeared to be no elongation except when the bolts failed, and then only as successive threads failed in the test.

Tests by the Bureau of Standards—Since the manufacturers refused to co-operate in an investigation and held that they were not responsible in any way, the problem was taken up with the U. S. Bureau of Standards, which carried on an extensive investigation in 1914-15. In general, the conclusion was that the material was found free of faults and flaws, but gave evidence of extensive cold work during manufacture, in the elongation and the fineness of the grains. Bolts showed a structure characteristic of overheated material and generally associated with brittleness.

Heat Treatment Proves a Success—From a study of the Minneapolis conditions, and in advance of the report of the Bureau of Standards, it was concluded that annealing would solve the problem, although such treatment by the manufacturers was unsuccessful. A local company was found having an annealing oven large enough to take the strainer system for an entire filter unit. As the company could not give its use long enough for the material to be left to cool, the writer decided to retard cooling in the open air by covering the material with dry hydrated lime.

With the furnace at 1,300 deg. F., the material was introduced on an iron truck, being stacked carefully so as to avoid the chance of distortion. The furnace temperature then fell to 1,000 deg. for five minutes and then in three hours again reached 1,300 deg., which was maintained for an hour. Upon withdrawal, the truck and material were covered with 6 in. of hydrated lime and placed in a shed for 14 hours, when the lime was removed and the material was found cool enough to be handled with bare hands. This work was done in a winter night, during which the temperature of the shed fell to 20 deg. F.

A filter unit built up of this annealed material was found in perfect condition after operation at maximum capacity for 60 days. It was then decided to anneal all the material. For this treatment, 1,300 deg. was found to be about the critical point; if the temperature was much lower the annealing would be imperfect, while if it was much higher the material would be damaged. New material stood the treatment satisfactorily but much of the material which had been in use even a short time would be broken, cracked or checked after annealing.

Trial of Monel Metal—Some of the filters were equipped with Monel-metal bolts and strainer plates, and before designing the filters built in 1919-1921, two units having the bronze and Monel-metal equipment were examined. The latter was as bright as when placed in 1915, but the former was very dark. It was then decided to use Monel metal in the new filters, although at much greater expense. This metal, delivered in sheets, was cut and bent cold and the holes wer drilled. After several years' continual service not a single failure has occurred, so far as the writer knows. The annealed bolts and plates have given satisfaction for about twelve years. Thus ended the trying and costly problem at the Minneapolis filter plant.

As to the increased cost noted above, a less expensive strainer system could have been put in if we had wished to change the design. For example, perforated pipe could have been used, as the writer did later in the iron-removal plant at Memphis, Tenn.

Brass Wire Cloth—Although the use of brass-wire screen cloth between the gravel and sand of filter beds is now obsolete, it may be noted that this material in the old Minneapolis filters (see Fig. 1) would turn a dark color and break easily after about one year. This would occur also if the filter alum got on the cloth, showing that corrosion took place. At Memphis, Tenn., an aerator put in operation in 1924 at the water-works consisted of coke layers in concrete trays with wire-cloth bottoms which became corroded and rotten in seven or eight months. It was found that the cloth was made of hard-drawn common brass wire (65 per cent copper and 35 per cent zinc), but for this purpose the manufacturers recommended brass of about 80 and 20 per cent copper and zinc, respectively, or else Monel metal. Water raised by the air-lift is delivered to the aerator, and at both Memphis and Minneapolis the water coming in contact with the bronze and brass had about the same content of dissolved oxygen and carbon dioxide, as shown by the accompanying table.

WATER AT MEMPHIS AND MINNEAPOLIS

	Dissolved Oxygen, P.p.m.	Carbon Dioxide, P.p.m.
Minneapolis, Minn.		
Raw water		0 to 7
Settling basin	7.7 to 10.6	0 to 9
Combined effluent	8.0 to 13.3	4 to 30
Memphis, Tenn.		
Before air-lift pumping	Nil	110 to 125
After air-lift pumping	8 to 10.4	26 to 30

Other Failures of Composition Metals—A paper on "Brass in Engineering Construction," in 1914, by Alfred D. Flinn, then deputy chief engineer of the Board of Water Supply, New York, stated that: "Unexpected metallurgical developments have occurred in the smaller objects, such as bolts, ladders and pipes." The failures were not confined to any one manufacturer or kind of bronze. Annealing and hot rolling failed to overcome the trouble. At the Catskill aqueduct: "Large number of brass bolts were found cracked and broken in their packing cases after storage through the winter, but never having been stressed. Others never exposed to low temperatures have been found in a similar condition. Flat bars, rolled plates and long rods supporting only their own weights have been found cracked or severed after a few or many months." [See also *Engineering News-Record* of Nov. 26, 1914, p. 1092; Sept. 16 and Oct. 21, 1915, pp. 572, 805; July 13, 1916, p. 87, and July 18, 1918, p. 132.—EDITOR.]

Experience at Grand Rapids, Mich.—Failures of bronze strainer plates have occurred also at the Grand Rapids filter plant. Conclusions presented in 1924 by Lloyd C. Billings, chemist-in-charge, were comparable with those reached at Minneapolis. Failure of the plates was mainly by fine hair cracks starting at the bolt holes. The plates were bolted too tight, so that their contraction in low winter temperatures set up undue stresses. Tension tests gave no information as to the cause of failure, but etching of failed material showed conclusive evidence of poor quality. Analysis showed that the metal did not meet the specified proportions of 85, 10 and 5 per cent of copper, zinc and tin respectively.

As the plates were in place for some months before water was turned on, they were exposed to the weather and probably were wet most of the time. Moisture on the surface of metal is usually saturated with oxygen, and in most cases the carbon dioxide of the air is fairly high, so that these elements had full access to the wet metal under conditions favorable for corrosion. When new plates were placed, operation was started, thus excluding the corroding gases. As no failures occurred afterwards, and the water is free from carbon dioxide and has been treated with lime, it is natural to conclude that the carbon dioxide, either with or without the presence of oxygen, was a factor in these failures.

Contrary to the experience at Minneapolis, Pittsburgh, Grand Rapids, Evanston, Memphis, New York and elsewhere, no cracking of strainer plates or bolts has occurred at Cincinnati, St. Louis, Louisville, Columbus, Ohio, and many other places. It appears that none of these latter cities have free carbon dioxide in the water that reaches the filters. In F. N. Speller's book on "Corrosion," 1916, great stress is laid on the hydrogen-ion and electrochemical theory of corrosion, which seems to bear out the conclusions reached in other ways.

Conclusions and Remedies—Failures of brass and bronze in the Minneapolis filters were not due simply to faulty manufacture or composition, though these were factors, but were due also to excessive internal stress set up by cold working of the metal and subsequent corrosion by external agencies. Carbon dioxide in the presence of moisture plays an important part in corrosion and may be assisted by the presence of free oxygen. Such corrosion takes place near large industrial cities, where the carbon dioxide content of the air is relatively high. This effect has been noted above in relation to brass-wire screen cloth.

In the absence of excessive external stresses, two things are necessary to produce failure: (1) Initial internal stress caused by cold working or too rapid cooling of the metal; (2) the presence of some active corroding agent in combination with moisture. To overcome the difficulty, two methods suggest themselves: (1) Relieving internal stresses either by careful annealing or by removing the outer skin or portion of the metal; (2) preventing corrosive action by some agent, such as lime, to neutralize the carbon dioxide before the water comes in contact with the metal.

The Minneapolis experience has been described fully, as being typical of failures at other places. It was there that the first extended publicity was given to the subject, and where the first results were obtained in solving the problem and overcoming the trouble. The writer was in direct charge of the work and was familiar with all its details.

Manitoba to Expend $3,500,000 on New Highways

An extensive highway construction program for the next fiscal year, commencing May 1, is planned by the Manitoba (Canada) government. Of the $3,500,000 involved in the program, $1,500,000 will be expended in the extension of the provincial trunk highway, while a similar amount will be expended on surfacing other stretches of the provincial roads. The construction program includes about 350 miles of highway and the surfacing and resurfacing program includes 200 miles of new work and 250 miles of resurfacing.

Welded Steel Frames for New Factory Buildings

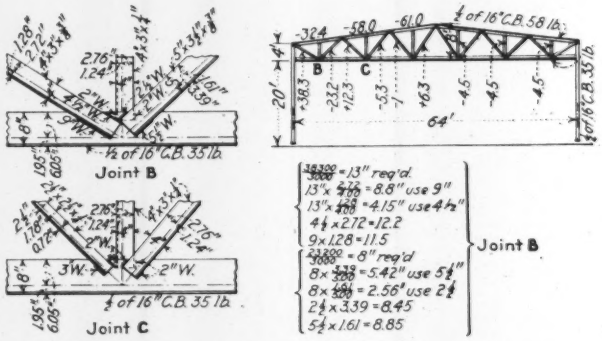
Plant Structures at Bridgeport, Conn., and at Pittsfield, Mass., Being Erected by This Process

By Andrew Vogel

General Electric Company, Schenectady, N. Y.

FOLLOWING on the completion of a large welded factory building at its Philadelphia plant, the General Electric Company has now under way two other building projects in which welding is being used. The Philadelphia building was described in detail in *Engineering News-Record*, May 17, 1928, p. 766, and some of the details of the two projects now under way are given herewith.

At the Bridgeport, Conn., plant, welded trusses of 64-ft. span are being constructed. These trusses are



WELDED TRUSS FOR BRIDGEPORT PLANT AND METHOD OF CALCULATING JOINT CONNECTIONS

unique in that the upper and lower chord sections each consists of one-half of a rolled I-beam, the beam being split in half by the use of a torch, so that the single-angle web members can be directly welded to the web of the chord members. The drawing shows one of these welded trusses together with the method of calculating a typical joint. The calculation illustrates the method of applying the proper amount of welding on each side of a single angle so that the center of gravity of the angle corresponds with the center of gravity of the amount of welding used. In other words, moments about the center of gravity of the angle produced by the amount of welding used were made equal so that no unbalanced moment would be transmitted to the member or unequal unit stresses applied to the welds.

The other job is a new welded building to be erected at the Pittsfield, Mass., plant. This will be a two-story structure of beam and column construction about 40 ft. wide by 280 ft. long, containing about 250 tons of steel. The building will consist of steel frame, brick pilasters, base and cornice, and steel sash. Floors and roof will be of concrete. Since the building will be erected adjacent to other buildings, the elimination of noise by the use of welding will be of considerable importance.

In the design of these projects, the same principles were used as in the design of the trusses for the Philadelphia building. Stresses of 3,000 lb. per linear inch of fillet weld were used in proportioning the joints.

Improved Garbage Collection and Disposal at Flint

Under City Engineer Hog Feeding Is Rehabilitated, Stock Is Augmented and Tractor Collection Equipment Is Increased

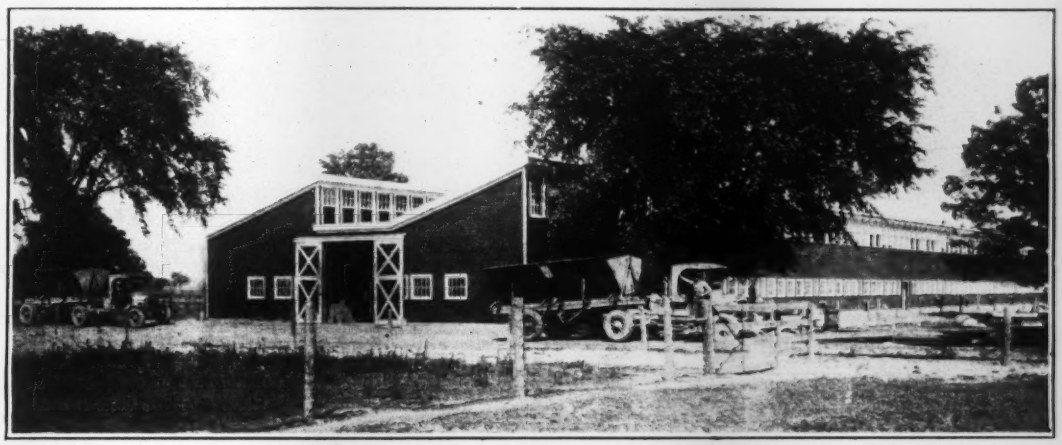


FIG. 1—HOG BARN AND SEMI-TRAILER WAGON

THE collection of garbage at Flint, Mich., and its disposal on a hog farm 12 miles from town were taken over by the engineering department of the city in May, 1927, following a separation of the garbage department, under which it was formerly operated. This market and garbage department displaced the earlier contract system several years ago. The collecting equipment was immediately augmented and the hog farm rehabilitated in order to make it sanitary and give less cause for complaint, with a view to offsetting theatened attempts to have the farm abandoned. The city had a population of 140,000 in 1927, and the garbage-collecting service covers an area of 33 square miles.

For delivering the garbage to the farm, auto-tractors haul side-dump semi-trailers and trailers having V-shaped bodies of 8- and 10-cu.yd. capacity. These, shown in Fig. 1, have proved satisfactory in handling the increasing quantity of garbage, and it is believed that the trailer equipment will enable even greater amounts of garbage to be hauled without any more motor trucks or power units. Collection is made by 1-ton motor trucks provided with dump bodies of special design and of special size to accommodate not more than a safe overload.

The former plan of using the motor tractors to distribute the garbage on its arrival at the farm was not satisfactory, either as to feeding or as to efficient use of equipment. A 5-ton crawler tractor now releases the hauling equipment upon its arrival, the tractor then distributing the material at proper feeding times. A specially designed two-wheeled truck, or "dolly," is used to handle the semi-trailers.

When the farm was turned over to the engineering department, its condition was far from satisfactory. Garbage had been fed mostly on the land, and very little if any liming had been done to control odors and keep the soil from becoming acid. The main building (Figs. 1 and 2), 60x300 ft., originally designed as a feeding pen, was repaired, and now has concrete feeding platforms on the ground floor, with sleeping quarters on upper-level balconies approached by ramps having a slope of 1 in 4. In addition, a new barn 30x105 ft. was built to house grain and supplies, while much work was done on the water lines, gates and fences. At the present time the condition of the farm is said to compare favorably with that of neighboring farms, and complaints have ceased.

There were 1,078 hogs on the farm when it was taken over in the early part of May, 1927, of which 500 had been bought since March 1. The main building has a normal capacity for about 2,500 light hogs or 1,500 heavy hogs, and is used for winter feeding. Purchases and sales go on continuously and will be varied as necessary to meet the rise and fall in the amount of garbage. On March 1, 1928, there were about 3,500 fine hogs, approximately three times the total number carried during the winter in past years and exceeding the maximum of past

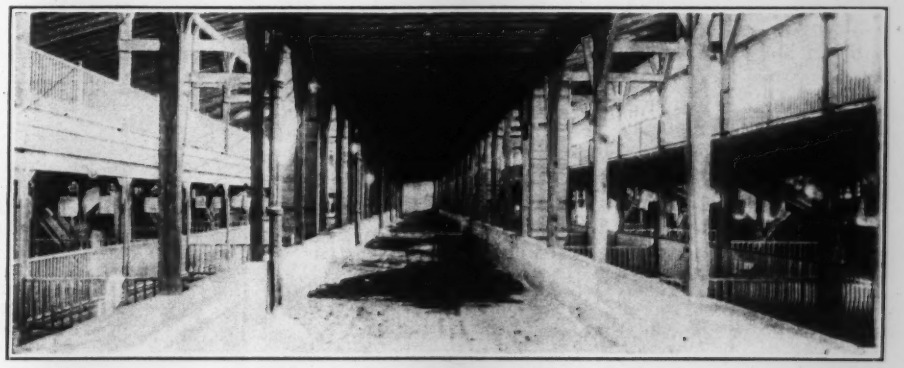


FIG. 2—INTERIOR OF HOG BARN
Feeding pens on each side. Sleeping quarters above.

FIG. 3—FEEDING HOGS ON FARM IN SUMMER

summers. In June the number had been increased to 5,500, and it is expected that about 6,500 to 7,000 hogs will be required this summer, reaching a peak early in September. In winter, the minimum will be about 3,000 to 3,500.

The farm includes approximately 300 acres, of which about one-third is used for raising corn, oats and alfalfa. The Flint River and two small streams, all bordered by wooded areas, traverse the farm and provide a good supply of water and ample shade protection for the large number of hogs that must be kept outside the main building during the summer. These hogs are fed in the open on movable platforms, as shown in Fig. 3. A small portion of the farm is reserved for the distribution of refuse during the year and the remainder, outside of the wooded areas, is left for open fields for the hogs. During the winter the hogs are turned out in the yard while garbage is being spread on the platforms of the feeding house and the sleeping quarters are being cleaned.

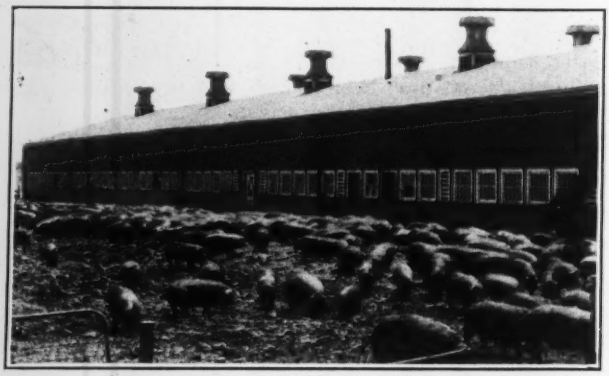


FIG. 4—HOGS IN BARNYARD IN WINTER
Hogs turned out while pens are cleaned and garbage distributed on inside feeding platforms.

Feeder hogs weighing about 120 lb. are purchased in the St. Paul district and shipped directly to the farm siding. The alfalfa and oat fields are used for pasture for the first two weeks after the arrival of the hogs. Running in open fields and feeding on the green pasture, with an abundance of shade and fresh water available, seem to give the new hogs the best treatment possible after their heavy inoculation against disease and long trip from St. Paul. Immediate losses after arrival have been reduced to less than 1 per cent. Following this two weeks the hogs are given small amounts of selected garbage. At the end of the fourth week they are on garbage feed entirely, and so continue until marketed. The corn and such oats as are not pastured are harvested and substituted for the green feed for the first two weeks for shipments received during the winter. Oat straw and shredded cornstalks are used for winter bedding.

It was thought that in the winter a weekly collection of garbage would be sufficient, except in the downtown district, but this did not prove practicable because of the continued large quantities collected. Minimum amounts have been from two to three times the amounts reported in previous years, due to the increase in population and to covering outlying districts which had not been included formerly. With ten 1-ton trucks, from 45 tons in winter to more than 100 tons in summer were collected daily. These trucks (Fig. 5) have special wide and shallow bodies. The collection loads averaged 1.4 tons each and were collected daily from 24,667 houses on a twice-a-week schedule. Householders are required by ordinance to keep garbage separated from papers, cans and ashes. Daily stops were made at 197 restaurants and stores. The average amount collected was approximately 56 tons daily, or 0.814 lb. per capita and 4.54 lb. per house, at a cost of $4.426 per ton. The cost of hauling the garbage to the hog farm was $0.773 per ton and the disposal or farm expense was $1.758 per ton, making a total cost of about $7 per ton for collection, hauling and disposal. Five 1-ton trucks collected eighteen loads of tin cans and dry refuse per day from 26,772 houses, or an average of one collection each three weeks, at a cost per load of $4.88, or 6c. per house per collection.

Hogs are sold on open market or to serum companies. Top prices, or 15c. to 25c. higher than top market prices, have been obtained in every case. During the fifteen months ended in June, 1928, the gross return, deducting all losses on the farm, has been nearly $8 per hog. On the present basis of operation, it is expected that at least 15,000 hogs will be put through the farm this year, and the gross revenue should take care of the entire operation of the farm and the cost of the 12-mile haul by tractor-trailers. It should also reduce the cost of collection, although it is not expected that the return from the farm will ever pay for this cost entirely. Losses due to razor blades, phonograph needles, bits of glass and other hidden illegal refuse are now much less than 5 per cent. No epidemics have occurred for several years. Small dead animals are collected and buried on the farm. Large dead animals are collected by a local rendering company.

Management of the hog farm and the collection system are under the direction of H. G. McClure, city engineer, and Homer Vette, general superintendent, with ten men at the farm and two men on each collection truck.

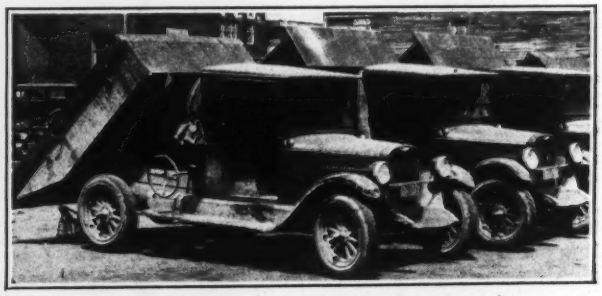


FIG. 5—MOTOR TRUCKS FOR GARBAGE COLLECTION HAVE SPECIAL BODIES

Accuracy of Stream-Flow Measurement

Tests on New York State Rivers Show That Current Meter Gagings Give Consistent Results When Made Under Proper Conditions

By Kendall K. Hoyt
U. S. Geological Survey, Albany, N. Y.

SMALL-SCALE experimenters say harsh things of stream-gaging methods. Measuring trickles in a pail may be an aid toward improvement, but cannot be extrapolated quite to include the Mississippi. No real test of records involving large flow will be possible until unknowns have been defined by research on streams of commensurate magnitude. Meanwhile, should one inquire as to the accuracy of quantitative results, there is often no answer. General practice can be judged only by such cases as permit analysis. The following are presented as typical.

Hudson River—Few drainage systems are under such detailed investigation as the Hudson River and its tributaries. Only the watershed above Spier Falls is here considered. In this area the U. S. Geological Survey maintains four gaging stations on the main stream at varying intervals almost to its source. The three principal tributaries are also gaged: Sacandaga River at two points, Schroon and Indian rivers at one each. In addition, the International Paper Company keeps record of flow from Spier Falls dam into the pond at the Sherman Island plant.

The Sacandaga River meets the Hudson at Hadley, 11 miles above Spier Falls. There is an automatic water-stage recorder on each river at Hadley above the point of confluence. Since inflow between these two stations and Spier Falls is small (the ratio of drainage areas, lower to upper, being 5,909 square miles to 5,789 square miles, or 1.02), the combined discharge at Hadley over a given period should nearly equal that at Spier Falls. Actual records are given in the accompanying table.

AVERAGE DISCHARGES, HUDSON RIVER, IN SECOND-FEET

	Year Ended Sept. 30, 1926		Year Ended Sept. 30, 1927	
	Discharge at Spier Falls	Sum of Hadley Stations	Discharge at Spier Falls	Sum of Hadley Stations
October	5,073	5,088	4,338	4,372
November	9,193	9,091	8,607	8,457
December	6,474	6,442	3,153	3,111
January	3,606	3,579	2,173	2,165
February	2,723	2,729	2,408	2,368
March	2,728	2,719	9,183	9,096
April	17,091	15,815	8,827	8,786
May	11,880	11,772	8,093	7,954
June	4,775	4,792	3,299	3,243
July	2,758	2,791	1,834	1,824
August	2,098	2,076	2,364	2,330
September	2,507	2,620	2,603	2,586
Average	5,908	5,789	4,747	4,698

For 1926, the ratio of mean annual discharge is the same as that of the respective drainage areas, or 1.02; for 1927, 1.01. Slight discrepancies in monthly values are accountable to inflow, time of concentration between points and reservoir regulation behind Spier Falls dam. Thus the two records are almost identical.

The Hadley figures are based on station ratings by the Price current meter. These are applied to gage height charts to obtain mean daily discharge, then corrected for backwater due to ice or other channel obstructions, all in accordance with methods standard throughout this branch of the service, as described in texts and government water-supply papers. To detect errors, daily discharge at stations on the same or confluent streams is plotted in the form of hydrographs which are carefully compared.

Flow at Spier Falls is divided between turbine draft for the Sherman Island plant and spillage over the dam. The former is determined from chart records of four Venturi meters calibrated by fifteen current meter measurements made from a cable at the mid-point of a concrete-lined canal 3,800 ft. long. The measurements check each other within a mean square error of 0.7 per cent. Later measurements made periodically during plant operation agree within 1 per cent of the Venturi readings. Spillage is computed from a current meter rating of the dam. This work at Spier Falls is in the hands of A. H. Davison, resident engineer of the International Paper Company, formerly employed in the Albany office, U. S. Geological Survey.

The two records here cited are entirely independent. Their agreement cannot be regarded as an absolute check of stream-gaging methods inasmuch as all base data were obtained by current meter. They do, however, indicate that standard practice will give consistent results under a variety of channel conditions. The next case is further evidence to the same effect.

Black River at Watertown—The Black River is one of the principal power-producing streams of northern New York. In order to provide data for development and regulation, the Geological Survey maintains eleven stream-gaging stations within the drainage basin in cooperation with the Black River Regulating District and the State of New York. Of these, the station at Watertown, near the river's mouth, is most important, because its records must be continually available to control reservoir gate operation, being transmitted for this purpose to the office of the regulating district by means of a long-distance recorder.

In the spring of 1927 reported discharges were found at variance with those computed from power output records of a near-by plant. Measurements are made at Watertown from a 300-ft. cable 150 ft. below a concrete highway bridge. The water, shallow at this point, runs turbulently over jagged rock ledges. It was thought that the usual parabolic distribution of vertical velocities might be upset by turbulence and the effect of the bridge piers above. Vertical velocity curves, determined to test this idea, showed, however, that the mean of the 0.2 and 0.8 velocities gave the true mean in verticals. As a further check, measurements were made from a bridge where the mean depth was 15 ft. as compared with 4 ft. at the cable. Results here agreed with those at the usual section. The disagreement with power plant figures was caused by a slight change in the stage-discharge relation due to silting at the control section. This condition had been shown by measurements during the winter, but the divergence was laid at the time to ice effect.

In this case the shift in control has no bearing on the discussion; it would soon have been discovered by routine check measurements. The essential point is verification of standard methods. This is still a check of meter work against meter work, since quantities based on power output are not available in a form for comparison. However, the third example includes an independent means of measuring.

Mohawk River at Cohoes—Among the modern hydroelectric plants of New York State, that of the Cohoes Light & Power Company, on the Mohawk River at Cohoes, stands in a high place. Indicating devices are of the best. Records are such that daily discharge may be computed from a combination of power draft, spillage and diversion to check the results at a Geological Survey gaging station below the tailraces of the plant. There is no independent method of determining spillage; therefore, to test the accuracy of the station rating, we have selected a period during which little water was passing over the dam. Leakage through the dam plus diversion for municipal purposes is taken as 45 sec.-ft., which is a fair average and, in any event, not large enough to make a significant change in the total. Turbine ratings are based on Gibson tests.

In June, 1927, the mean daily discharge was given as 2,380 sec.-ft. by the company and 2,450 by the Survey. The difference of 2.9 per cent, not in itself a bad check, was caused by wearing of the turbines subsequent to rating—the runners were found pitted on dismantling last summer. Therefore the current meter results seem to approach the truth as closely as known methods permit.

The foregoing examples are typical in that they reflect practice generally followed throughout the world. It is shown that the Price meter, when employed by experienced personnel, can give consistent results under different channel conditions and that it checks the much-praised Gibson method. The records cited are shown to be more than sufficiently accurate for their purpose. As to indicating the validity of practice as a whole, the stated cases strengthen the general belief that records of river discharge collected under standard methods may be used with confidence.

Those who have had to do with the development of instruments and methods for measurement of flow in open channels have utilized all available data to the end that results may be of the highest possible precision. The subject requires more experimental work for which facilities are not now available. As an agency to fill this need, the proposed hydraulic laboratory under the Bureau of Standards would be ideal. Pending the results of research, such cases as are here given indicate progress. One can infer that the art of stream gaging has passed far beyond the stage of divining with a forked rod of peeled willow.

Water Supplies in Wisconsin

Of the 274 Wisconsin municipalities having public water supplies (exclusive of fire protection), 33 obtain water from surface waters, 73 from shallow wells and 168 from deep wells. During 1927 the State Board of Health investigated 129 of these supplies, in accordance with a program which provides for examination of such supplies once in one, two and three years respectively. At Rhinelander, the typhoid fever records and analytical results showed the water supply to be unsatisfactory, and action has been taken by the board to insure necessary improvements.

Effect of Distance on Automobile Operating Costs

Unit Value of Distance Overestimated—Car Operating Costs Affected by Distance Seldom Exceed 3c. a Mile

By N. D. Douglas

Assistant Engineer, Division of Highways, Sacramento, Calif.

THE highway engineer often finds it necessary to consider the value of distance when comparing alternative road locations. A certain initial additional expense to reduce distance is usually justified. Roughly speaking this is the capitalized value of the saving effected by the distance reduction. This saving consists of two parts: (1) the possible saving of roadway expense, and (2) the saving in the cost of operation of traffic.

Cost Estimates—It is believed that most engineers make only rough estimates, based on arbitrary assumptions, of the effect of distance on operating costs and that they are inclined to overestimate its unit value. In engineering reports the usual claim is that highway distance reduction will save from 6c. to 12c. per car-mile, and this saving is balanced against other cost items to determine the feasibility of a project.

In Bulletin 69, "Highway Transportation Costs," Engineering Experiment Station, Iowa State College, it is shown plainly that vehicle operating costs should be divided into mileage costs and time costs; the former are due directly to mileage, and the latter are independent of mileage and due to time of service only. Based on a large number of experiments, observations and collected data, the same bulletin suggests that the average costs of operating trucks and passenger automobiles are as given in the accompanying table.

Obviously license, garage, insurance and interest charges are time costs independent of mileage. Our investigation, then, should consider only the items of gasoline, lubrication, tires, maintenance and depreciation. Passenger cars will be considered first.

Gasoline—It is assumed that the figures in the table represent the over-all cost of average operation, including stopping and starting, idling, warming up, operating in city traffic and over various types of roads, choking, etc. It is estimated that fully 10 per cent of the gasoline used by the average car is wasted by these operations. Highway distance will not affect this waste, but will affect gas consumption only on the open road.

For example, a Ford touring car in good condition will deliver 18 to 20 miles per gallon of gas in city operation and about 27 miles per gallon on long runs at about 30 miles per hour through average country. If 20 per cent of the car mileage were in city traffic, the gas consumption would be 10 per cent greater than it would be if the total mileage were on the open road.

A modern car of the $1,000 to $1,800 class will make 14 to 16 miles per gallon of gas under ordinary conditions on a concrete road of moderate grades. At 22c. per gallon, the gasoline cost would be about 1.38c. to 1.46c. per mile.

The lighter cars average 20 to 30 miles per gallon of gas, which costs 0.73c. to 1.10c. per mile. A survey by National Automobile Chamber of Commerce covering 17,000,000 cars owned in the United States in 1926 indicates that about 64 per cent of them were cars whose

list price was $800 or under. The proportion of heavy cars above the $1,800 class is very small. An average open road gasoline cost for all cars based on a conservative average of the foregoing figures would be about 1.28c. per car-mile.

Lubrication—Oil consumption also should be considered only for open road operation. The average modern car in fair condition uses 4 to 6 qt. of oil in the crankcase, plus an additional quart about every 200 miles, or, say, 8 qt. per 800 miles if changed every 800 miles. California prices range from $0.30 to $1.40 per gallon for various oils. A conservative average for the individual consumer would be about $1.10 per gallon, or 0.28c. per car-mile.

Most new cars will use only the amount required to refill the crankcase every 800 or 1,000 miles, or barely three-fourths of the amount allowed above. For future estimates, 0.21c. per car-mile is considered a sufficient allowance for lubrication under ordinary conditions. The item of greasing is too small to be considered.

Tires—The usual assumption that tire costs vary directly with mileage is an error. Wear resulting from rim cutting, under-pressure, punctures, wheels out of alignment, running off pavement shoulders, bruises, skidding, exposure, etc., cannot be laid to highway distance.

In Engineering Bulletins 16 and 17, "The Relation of Road Surface to Automobile Tire Wear," published by the State College of Washington, experiments are described that indicate that tires will last about 40,000 miles on pavement. Mileages of 20,000 or more are not unusual. The writer has averaged better than 15,000 miles on a combination of all kinds of roads, some very rough, and driving a car only about 7,000 miles a year.

A set of four good high-pressure tires and tubes for a Ford car costs about $48. A set of the best balloons for a Buick Master Six costs about $160. A high average between these extremes would be $100, which, with a life of 20,000 miles, would indicate a tire cost of 0.50c. per car-mile. This mileage is obtained, or exceeded, by taxicab companies, buses, etc., operating on pavement.

Maintenance—The maintenance cost is the most variable item. It includes repairs due to rusting, accidents, faulty lubrication, excessive speed, painting, brake band renewals, etc., and therefore does not vary directly with highway mileage and is increased considerably by operation in city traffic. In the absence of more adequate data, the item of 1.24c. per car-mile shown in the table can be assumed correct although it probably is high.

Depreciation—The item of depreciation is mainly a time item. The resale value of a car is determined usually by its model and age. Obsolescence is a very important factor. A four-year-old car driven 20,000 miles is worth no more on the market than a four-year-old car of the same type driven 50,000 miles.

Considering the small ratio that the usual distance saving would bear to the total car mileage, it would seem that the item of depreciation should not be considered ordinarily in figuring the value of distance.

Time—Another item often used in arguments for road improvements is "time" saved or lost by distance. The general belief that time is always worth money is a popular fallacy, because the average passenger car driver is not producing in the economic sense, and would not produce more or less if he reached his destination a few minutes earlier or later. Usually, at best, it would be a matter of only slight convenience. Suburban and commuting traffic is an exception to this general premise.

In the case of alternative routes involving long distances of several miles, or more, the value of time saving should be considered as far as concerns business traffic, but care should be used to hold the consideration within the limits of fact, avoiding extra expense for some imaginary benefit.

From the preceding count the distance cost items of the average passenger car can be tabulated as follows:

Item	Cents Per Mile
Gasoline	1.28
Lubrication	0.21
Tires	0.50
Maintenance	1.24
Total	3.23

These figures are based on fairly high prices and ordinary operation, and are more conservative than the claims of manufacturers. The writer's experience has been that his own costs have run lower. Increasing automobile efficiencies will tend to reduce the items, or at least to offset any price rises.

AVERAGE COSTS OF OPERATING MOTOR VEHICLES

Trucks				Passenger Cars			
Item		Cents Per Ton-Mile		Item		Cents Per Vehicle-Mile	
Driver	Time	2.29		Interest	Time	1.24	
License		0.10		Insurance		0.31	
Garage		0.29		Garage		0.83	
Interest		0.30		License		0.59	
Insurance		0.31					
Supervision		0.52	3.81				2.97
Gasoline	Mileage	1.00		Gasoline	Mileage	1.61	
Oil		0.12		Oil		0.31	
Tires		0.71		Tires		0.98	
Maintenance		0.99		Maintenance		1.24	
Depreciation		1.10	3.93	Depreciation		3.16	7.30
Total			7.74				10.27

Considering the average trunk highway, it is believed that, in general, expenditures for highway distance reduction may be premature or may represent economic waste if based on a capitalization of passenger car operating costs assumed to exceed 3c. per car mile.

Exceptional Cases—It must be noted that the preceding arguments are based on present-day average conditions with road speeds averaging from 30 to 40 miles per hour. Road speeds are increasing yearly, a fact tending to increase cost of operation. On a certain proportion of the existing and proposed roads the location and alignment are such as to allow unlimited speeds. But there is a practical upper limit to automobile speeds determined by considerations of safety, economy, motor design, etc. The railroads of the country have found that 70 miles per hour is about the practical limit for trains. Much higher speeds can be and have been used but have proved impracticable. It is believed that the upper limit of highway speed will be about 50 miles per hour.

Almost no data on such high-speed operation are in existence, but theoretical extension of various data curves would indicate that the figures in the preceding tabulation should be increased about 15 to 30 per cent for speeds of 50 miles per hour. Therefore it seems that on projects involving unlimited road speeds passenger automobile operating costs may be assumed to range up to 4c. per mile, but care must be used to base the estimate on the average prevailing speed rather than the maximum speed.

Preponderance of traffic in one direction, heavy grades or curvature, a large proportion of business or commuting traffic and a number of extreme or unusual conditions would modify the figures in the tabulation, which,

as shown, apply to ordinary roads with average traffic and ordinary profile and alignment.

Truck Costs—Truck traffic conditions are very different. The table gives the average itemized cost per gross ton-mile for trucks based on observations of about 1,000 trucks. As many of the arguments applied to passenger traffic will fit truck traffic, the mileage total of 3.93c. per ton-mile probably is too high.

The time value effect of distance is tangible, especially as applied to drivers' wages. Grades seriously affect truck costs, and shortening of grade distances is usually desirable. On most roads the proportion of trucks is small, but growing. Operating cost data are obtained more readily than in the case of passenger cars. Truck traffic should be analyzed carefully in each individual case, as freight traffic is analyzed on a railroad, with special attention to commodities hauled, type of trucks, methods of hauling, grades, etc. In the absence of more extensive data, the table furnishes a valuable guide for estimating average truck costs, but each case is a problem in itself, and averages will not apply to trucks.

Conclusion—It is suggested again that highway engineers have been too much inclined to base location estimates on assumptions rather than on facts. As far as the item of route distance is concerned, this article has attempted to present a brief outline of facts to be used as a foundation for estimates. It is a fact that the total over-all cost of operating a passenger car may well be 6c. to 12c. per mile, more or less, but the highway engineer must divide and apportion this total to reach the proper solution of his location problems.

Comparative Strength of Concrete Pavement Cured by Three Methods

By Searcy B. Slack
Bridge Engineer, State Highway Department, Augusta, Ga.

TESTS were undertaken in 1927 on a concrete road 18 ft. wide, 9 in. thick at the edges and 6 in. thick at the center, built with a metal center strip and dowel bars 4 ft. apart through the center joint. There were no constructed transverse joints. The only joints were at the ends of the days' runs or where a shutdown of more than an hour was necessary.

Three methods of curing the pavement were used—earth and water, surface application of calcium chloride, and surface application of sodium silicate. On all sections the pavement was covered with damp burlap as soon at it could be placed without marring the surface. On the earth-and-water section the burlap was removed the following morning and the surface covered with about 2 in. of earth kept moist for ten days; the pavement was cleaned off at the end of fifteen to twenty days. On the calcium-chloride section the burlap was removed the following morning and the surface was covered with calcium chloride in flake form, using 2½ lb. per square yard. On the sodium-silicate section the burlap was removed the following morning and the surface was treated with a solution of sodium silicate, using 1 lb. of sodium silicate (42.5 Bé.) to each square yard. The silicate of soda was diluted with water, one part of water being mixed with three parts of silicate of soda to facilitate covering the surface.

After the pavement was from three to six months old 30 cores were bored, ten from each section, at random points along the sections. Four of the cores were damaged in boring or were faulty and were discarded. The cores were drilled with 5½-in. shot core drill. Four cores from each section were sent to the U. S. Bureau of Public Roads for crushing test and the remaining cores were tested in the state highway laboratory.

The concrete aggregates were quartz sand and rounded quartz gravel. The proportions were one part of cement to 5½ parts of aggregate (a nominal 1 : 2 : 3½ mix). The actual mix was approximately 1 : 1.8 : 3.7, correction being made for the bulking of the sand. The cement factor averaged 1.455 bbl.

A separate crack survey or crack count was made of each section when the average age of the section was six months. In determining the average slab length the total length was divided by the number of cracks plus the number of joints. The results of the tests were:

Section Cured With	Length, Ft.	Cracks, No.	Joints, No.	Averag, Slab Length Ft.
Earth and water	6,318	72	9	78
Calcium chloride	18,359	260	30	63.4
Sodium silicate	25,406	365	39	62.9

It was the original intention to make the sections approximately equal in length, but due to an abnormally dry spell in the late summer and early fall water was scarce and this plan was modified. Due to difference in length of sections and possible subgrade variations, too much importance cannot be placed on the difference in slab lengths. The average slab length on many projects in Georgia is just under 50 ft.

EFFECT ON COMPRESSIVE STRENGTH OF DIFFERENT METHODS OF CURING CONCRETE PAVEMENTS

Bureau of Roads Height, In.	Bureau of Roads Unit Load, Lb.	Georgia Highway Board Height, In.	Georgia Highway Board Unit Load, Lb.
	Calcium Chloride		
6.8	3,965	6.87	4,188
6.7	3,996	6.70	3,396
6.7	3,060	6.75	3,530
6.5	4,655	6.50	4,174
Average unit load	3,919	Average unit load	3,825
Average unit load of two above averages, 3,872			
	Cured With Dirt and Water		
6.7	4,270	6.75	4,262
6.5	4,895	6.13	3,714
6.8	3,590	6.63	3,966
6.6	4,045	6.75	4,085
		6.25	3,864
Average unit load	4,200	Average unit load	3,978
Average unit load of two above averages, 4,089			
	Cured With Sodium Silicate		
6.5	4,740	6.87	3,690
6.0	3,811	6.13	4,322
6.25	4,140	7.00	3,400
6.0	3,485	5.75	3,987
		6.25	3,442
Average unit load	4,044	Average unit load	3,768
Average unit load of two averages above, 3,906			

Remarks: All cores were tested at the age of 210 days. An average diameter of 5.35 in. was used in computing unit loads.

A rough test has been made of the surface texture of the concrete on the different sections. A heavy weight was dragged a few hundred feet on each section and the amount of surface scoring was noted. Several small areas of each section were rubbed with a carborundum brick in an effort to determine a difference in the resistance to surface wear. So far as could be determined by these rough tests no difference in surface texture was noticeable.

The pavement was laid by the Davis Construction Company, Atlanta, Ga., under supervision of the state highway department and the bureau of public roads. J. W. Lovell was resident engineer in direct charge of the work.

Bearing Walls Eliminate Columns in Apartment Building

Ten-Story Earthquake-Resistant Concrete Structure Has Flush Walls Inside—No Outside Finish Used

By Felix H. Spitzer
Consulting Structural Engineer
San Francisco, Calif.

A HIGH-CLASS apartment house, ten stories high, which has just been completed at Washington and Jones Sts., San Francisco, was designed so that the walls, of strongly reinforced concrete, would carry the loads to the foundation without wall columns. Another new feature is that the forms and pouring were so planned that it was unnecessary for good appearance to plaster or face the structure with some other material; the only finish is a single coat of concrete paint. The design was worked out so as to make the structure highly resistant to earthquake shocks.

The structure is 55x58 ft. in plan and has windows on all four sides, facing either streets or courts. Being nearly square in plan and having similar architectural treatment on all four faces, the structure forms a tower. It is topped with a lantern housing a water tank. From the wall foundation, which is a continuous spread footing, a 14-in. wall which acts as a retaining wall below ground extends to the second floor. Beween the second and the tenth floors the wall is divided into piers 12 in. thick and not less than 3 ft. 2 in. wide, having wing walls 10 in. thick in the second story and 8 in. thick above this level. In the tenth story, where special architectural treatment was used, the walls are 10 in. thick.

The design was worked out with special regard to preserving the continuity of the wall piers, whose width extends between window jambs. Each pier was proportioned to carry its own wall load and its share of the floor load. Spandrel beams occupy the full height from the window head to the sill of the window next above and are of the same thickness as the pier wing walls. This gives a flush face on the inside of the walls, which are plumb from the third to the tenth floor.

All walls are heavily reinforced with layers of vertical and horizontal steel at both faces, the reinforcing being 12 in. or less on centers and tied together every 2 ft. with $\frac{1}{4}$-in. wires. Additional reinforcing placed along the edges of all openings is made continuous in both directions. This consists of three $\frac{7}{8}$-in. bars in the lower stories, reducing in number and size of bars with the rising height of the building. Except where it is hooked around corners and at ends, all the wall steel is straight.

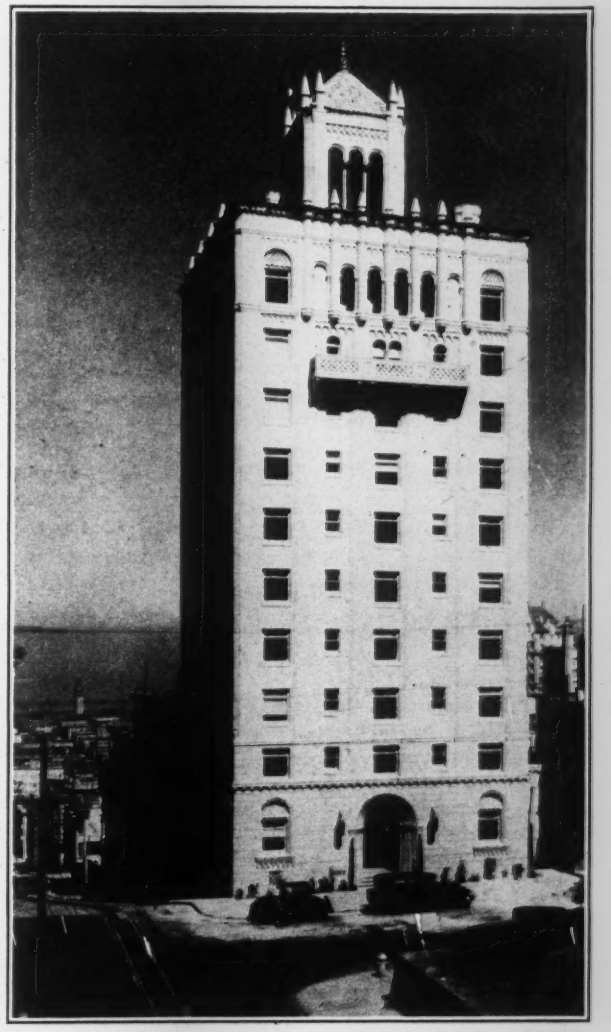
The structural design for the building was originally made in accordance with the building ordinances, which prescribe a wind load of 15 lb. per sq.ft. and require a skeleton wall frame with 6-in. curtain walls. The design was then changed to the form described, by increasing the concrete thicknesses where necessary and adding an amount of wall and wall-column steel which doubled the total reinforcing originally provided. As the cost of the reinforcing amounted to only about $16,000, the addition due to this increase was proportionately small. In carrying out the structural design, the requirements of the building ordinances regarding minimum dimensions of columns and column reinforcing were applied to the walls.

There was considerable saving in formwork, labor of laying out, plastering and other items, due to the absence of breaks at the inside face of the walls. More important, however, was the saving in floor space because the furring could be held close to the walls and did not have to be brought out to the face of projecting columns to produce flush wall surfaces in the rooms.

The saving in the outside plaster coat was a material item. Although the building has gone through one rainy season, the minimum wall thickness of 8 in. with the two layers of reinforcing has proved so effective that not a single leak developed nor have hair cracks appeared.

Design for Lateral Forces—The design was checked by an adaptation of the method developed by Van der May and Spitzer, described in *Engineering News-Record*, Jan. 19, 1928, p. 106, which is based primarily on the assumption that the floors are rigid planes and are rigidly connected to the columns and walls.

Considering a section midway of the second story, the action of the horizontal loading is resisted by four distinctive groups of columns and piers—namely, (1) the four corner piers, angle shaped and 6 ft. high, which is the height of the window openings; (2) the eight wall



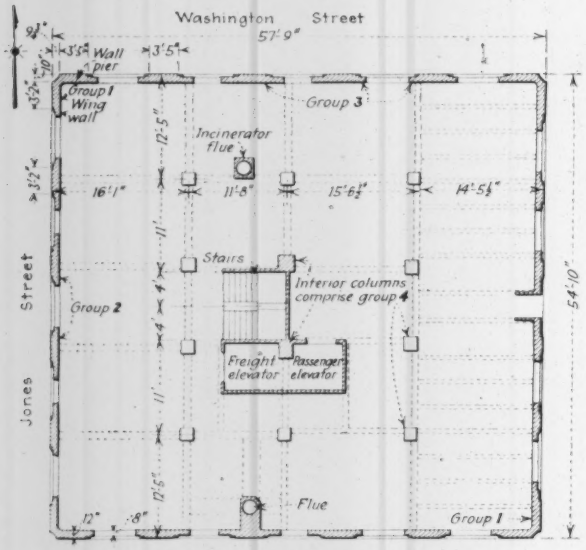
TEN-STORY APARTMENT BUILDING WITH NOVEL CONSTRUCTION FEATURES

Exterior surface had no treatment, other than one coat of paint, after forms were stripped. Ship-lap forms were used with clamps having countersunk sockets.

piers parallel to the direction of the horizontal loads and also 6 ft. high; (3) the eight wall piers normal to the direction of the horizontal loads and 10 ft. high, which is the clear height between floor slabs, and (4) the twelve interior columns, averaging 20x20 in. in section and 9 ft. high between beams.

The total horizontal loading was assumed to be *one-fifteenth of the dead weight* plus 10 lb. per sq.ft. for live load, which amounts to 445,000 lb. This is the equivalent of 75 lb. per sq.ft. of wind loading in north-south direction and 80 lb. in east-west direction.

The cross-section of columns and piers was considered. Although this may seem unusual, it must be remembered that these calculations are made for the emergency of an earthquake, and also that the new joint committee rules include the total area of the columns reinforced with longitudinal bars and separate lateral ties.



PLAN SHOWING SUBSTITUTION OF WALL PIERS FOR COLUMNS

The equations for shear and compression in any one column (n) are:

$$\text{Shear, } H_n = \frac{I_n}{h_n^3}\frac{\Sigma H}{\Sigma_1^n \frac{I}{h^3}} = \frac{I_n}{h_n^3} K.$$

Compressive stress in bending due to lateral forces,

$$f_n = \frac{6c}{h^2} K.$$

In these equations the free heights h are in feet, while widths c are in inches.

The necessary values required to calculate the unit shear and maximum compression are noted in Tables I and II. The calculations are made for load in north-south direction. No calculations were made for loading in diagonal directions. Adding values of column 9 in Table I, the following values are found:

$$\Sigma_1^n \frac{I}{h^3} = 19{,}956$$

$$K = \frac{445{,}000}{19{,}956} = 22.3.$$

William Edward Schirmer was architect for the building; the writer co-operated with him in the structural design. The general contractor was Charles W. Heyer, Jr.

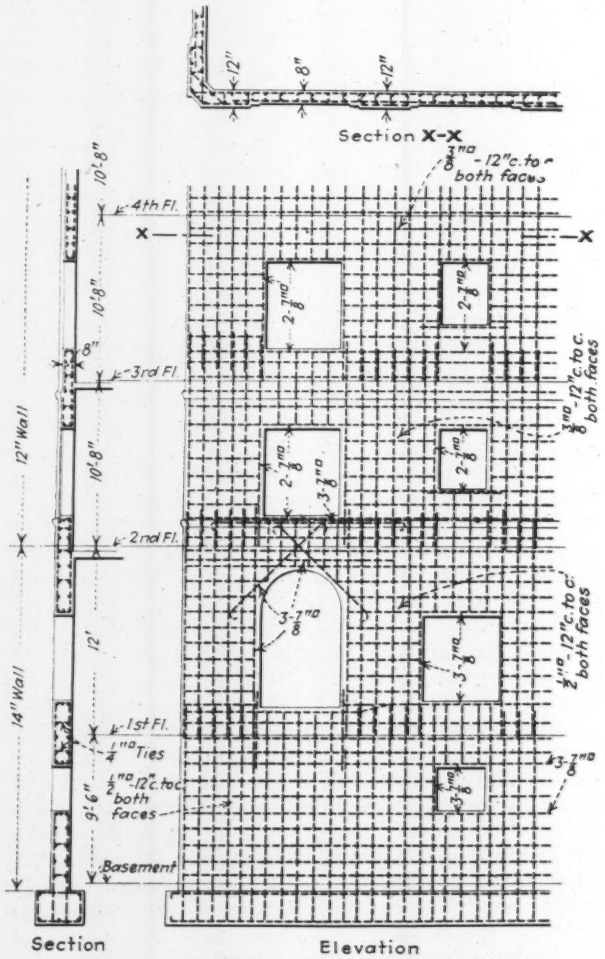
TABLE I

1 Group No.	2 Area, Sq.In.	3 Compression from Vertical Load, Lb. per Sq.In.	4 c In.	5 h Ft.	6 I in Lb.	7 $\frac{I}{h^3}$	8 No. of Cols. in Each Group	9 For Each Group $\Sigma \frac{I}{h^3}$
1	1,272	145	40	6	407,917	1,880	4	7,520
2	816	240	36	6	329,200	1,520	8	12,160
3	816	250	5.7	10	9,084	9	8	72
4	400	550	10	9	10,300	17	12	204

TABLE II

1 Group No.	2 Shear, $H = \frac{I_n}{h^3} K$	3 Unit Shear, Lb. per Sq.In.	4 Flexural $f_n = \frac{6c}{h^2} K$	5 Compression, Lb. per In.^{2} Total
1	42,000	34	150	295
2	34,000	41	140	380
3	200	..	4	254
4	230	..	17	567

Since completion of the structural concrete for the building, the designers' attention was directed to the method of shear distribution developed by Dr. Naito of Japan and presented in his book, a translation of which into English is now in process of publication. In this method, Dr. Naito gives consideration to the deflection due to shear in the short columns. As there is no great difference in the ratio $I \div h^3$ for the columns of groups 1 and 2 compared with those of groups 3 and 4, application of Dr. Naito's method will likely have but small effect on the resulting stresses.



ELEVATION SHOWING TYPICAL WALL REINFORCING

Difficult Sewer Construction in Wet Ground

Open and Sheeted Trench in Sand, Gravel and Muck With Never Less Than 20 Ft. of Groundwater Required Unusual Drainage and Pipelaying Devices

By H. G. Wray
City Engineer, South Bend, Ind.

DEEP trenching in water-bearing ground and adjacent to a small lake required unusual methods of handling water in building a 4½-mile sewer at South Bend, Ind. Complete emptying of the lake, 50,000,000 to 60,000,000 gal., and deep sump and well-point pumping, 4,000 to 5,000 gal. a minute, barely kept the water down so that, with a pipe-laying shield and steel-sheeted trenches, construction could go ahead. Some of the devices employed were original and effective and, with a few of the design details which were special, they merit description.

Sewer Structure—The sewer increases from 18 in. to 96 in. Vitrified pipe was used for all diameters, including some 10,000 ft. of 6-in. services, up to 27-in., and precast concrete pipe was used for larger diameters. A typical section of concrete pipe in a concrete cradle on piles is shown by Fig. 1. This drawing also shows a double drop manhole which was employed on this sewer. In this design the straight lead into the manhole shaft is primarily for stormwater flow. It permits a straight-line construction on the local sewer and makes it possible to clean it easily and with little expense. Thus the structure serves as a manhole for both sewers. During dry weather the discharge of the local sewer will be carried into the trunk sewer by means of the drop. Another special detail was the submerged outlet structure shown by Fig. 2. The details are clearly shown by the drawing, and mention need be made only of the extension of the outlet 50 ft. into the river and its flattened mouth designed to reduce visible nuisance and bad odors. It was, however,

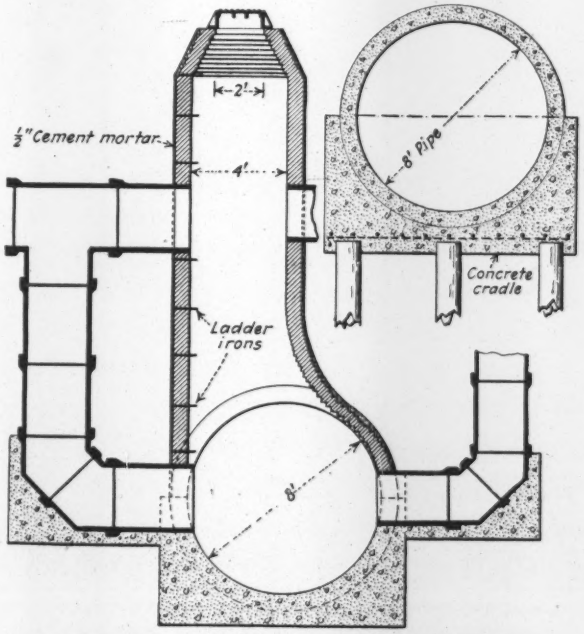


FIG. 1—SECTIONS OF SEWER AND DOUBLE DROP MANHOLE

the construction of the sewer rather than the structure that afforded the main problem.

Soil and Topography—With the exception of places where water, sand, quicksand, peat and muck were encountered, the general character of the soil was sand and gravel, ranging from fine to coarse. The soil in the Beck's Lake region (Fig. 5) was a soft, fine mud or muck. At such locations it was necessary to place wood sheeting in the bottom of the trench, remove the muck several feet below the grade line of the sewer and backfill with fine gravel to provide a firm bearing for sewer pipe. The contractor never had less than 20 ft. of groundwater. Difficult water conditions had to be met in several places, and they will be considered in order, following the map, Fig. 5.

Sheeted Trenching—For 3,000 ft. on Elwood St. deep trenching was required which developed some interesting methods in sheeting bracing and the use of trench machines. Here, although the contractor was permitted to occupy the full width of the roadway, an unbraced cut was impracticable and it was necessary to sheet and brace throughout and, as no storage space was available for excavated material, to backfill the trench over the 90-in. pipe as fast as the sewer was laid. Steel sheeting, 34 ft. long, was used for a cut approximately 29 ft. deep. Three steam cranes with pile hammers drove the sheeting. One also handled a clamshell for backfilling. About 900 sheet piles, sufficient for 510 ft. of trench, were provided; they were driven, pulled and moved ahead as the work advanced.

Pulling the steel piles was slow and costly at first, as two reversible steam hammers did not produce sufficient lifting power. A pulling device was then designed by the contractor, consisting of a traveling tower 52 ft. high with a boiler and two-drum steam hoist and tackle rigged up with five sheave blocks and eleven cables. This device, in conjunction with one reversible steam hammer, developed a lifting effort of 110,000 lb. and rapidly removed the piles.

The sheeted and braced trench is shown by Fig. 3. Excavation and backfilling were performed by a trench machine 100 ft. long on a 10-ft. gage track. The sewer pipes were lowered into place by a steam crane operating alongside the traveling frame. Quicksand was encountered along Elwood Ave. Through this material and at other points where the soil was unstable, a concrete cradle was provided to protect the concrete pipe against the impact and heavy loading from backfill.

Open Trench Construction—Most of the sewer, as indicated by Fig. 5, was in open trench. As the location was in the Kankakee marsh lands, drainage was the principal problem. At one point the contractor provided a pump pit or sump, and at another he assembled equipment for draining a thirteen-acre lake adjacent to the line of trench. In excavating the sump, the first cut of 21 ft. was made with a 3-yd. dragline having a 100-hp. Diesel engine. From the 21-ft. level, 16-ft. lengths of inter-

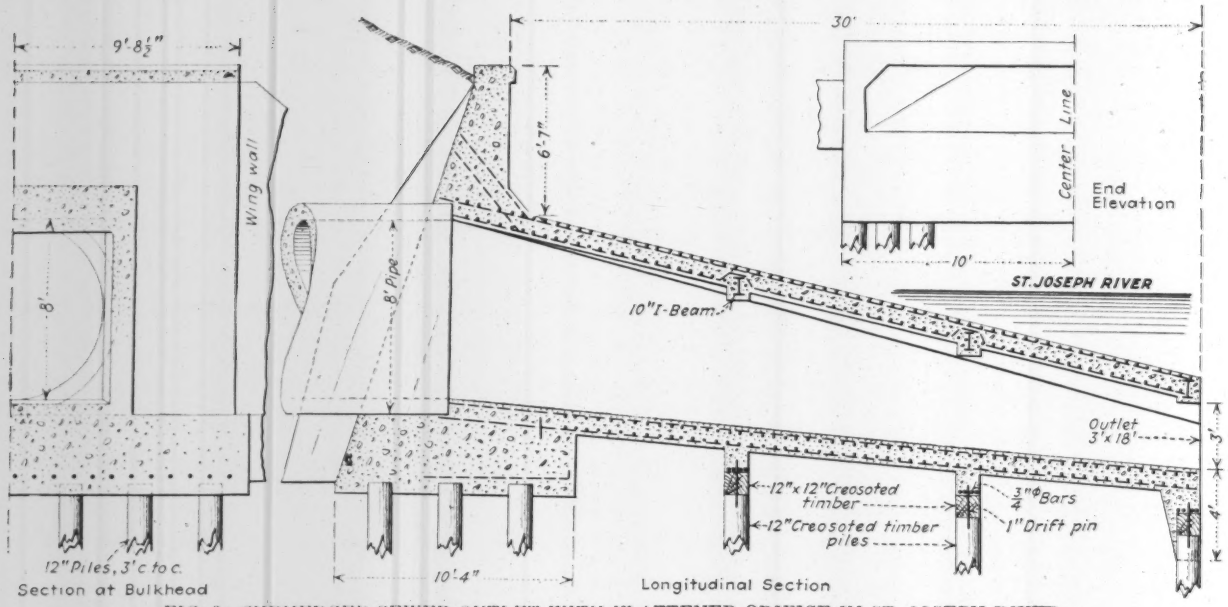


FIG. 2—SUBMERGED SEWER OUTLET WITH FLATTENED ORIFICE IN ST. JOSEPH RIVER

locking steel sheeting were assembled in the form of a rectangle and driven with steam hammers to a full depth of 16 ft., where the water-bearing gravel was encountered.

Upon this sheeting was erected a timber frame or shaft, and three motor-driven submerged centrifugal pumps were installed, being suspended from the timber frame, as shown by Fig. 4. Two of these were 8-in. pumps with 50- and 30-hp. motors; the other was a 6-in. pump with a 30-hp. motor. Their discharge of about 4,600 g.p.m. was delivered into a pond formed by a small earth dike, so that the sand would settle and only comparatively clear water would be carried to an existing sewer system by the outlet pipe. The pumps were installed in August, 1927, and by January, 1928, had lowered the groundwater level about 8 ft. After this level had been lowered appreciably sewer operations were begun at this point and extended south and westward through peat beds sometimes 20 ft. thick.

With open-trench construction, work became impossible without further lowering the water level. Triple-lap wood sheeting 20 ft. long was driven in the open cut and well points 12 in. apart were located at both the 15-ft. and 20-ft. levels, but failed to reduce the water level sufficiently. A sump was then formed by lowering a wooden box 8 ft. square and 14 ft. high. Below this box was driven a 15-ft. length of 48-in. steel tubing having ¼-in. holes 4 in. c. to c. around its entire inner circumference for the full depth of the tube. This ar-

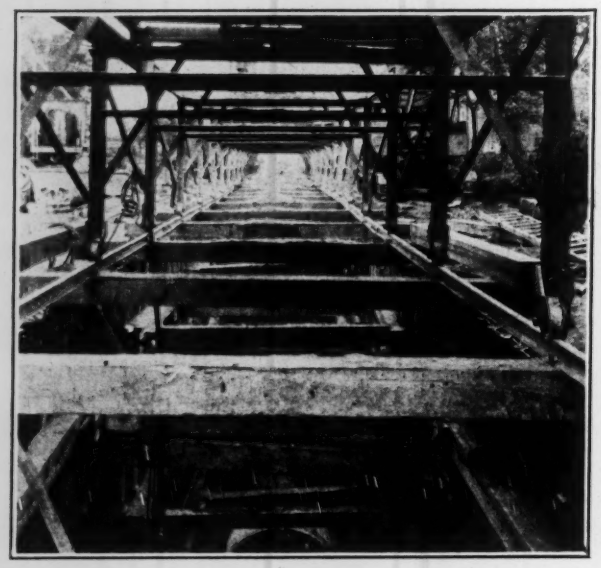


FIG. 3—TRENCH MACHINE ON 30-FT. TRENCH
Trench 12 ft. wide with steel sheeting and traveling trestle for excavating and backfilling. Concrete pipe 90 in. in diameter handled by crane.

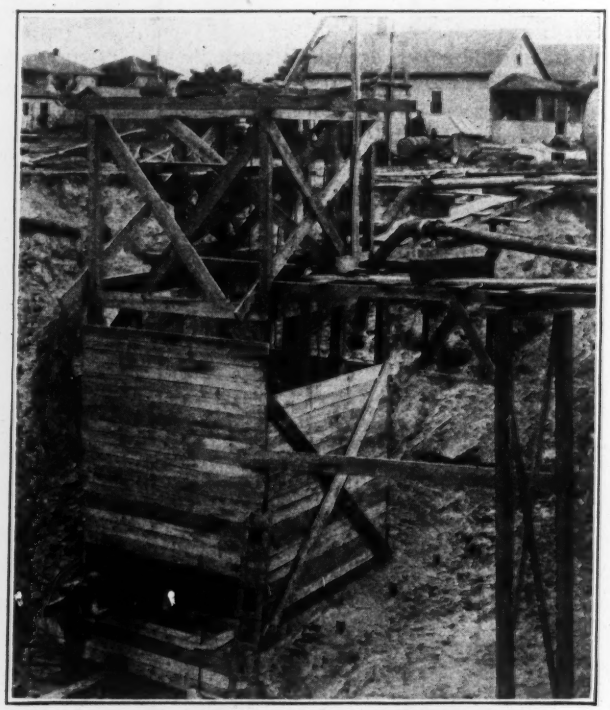


FIG. 4—DRAINING WET GROUND FOR DEEP OPEN TRENCH
Pump shaft rests on steel pile sump having its bottom 37 ft. below street level. Centrifugal pumps suspended by cables from the framework.

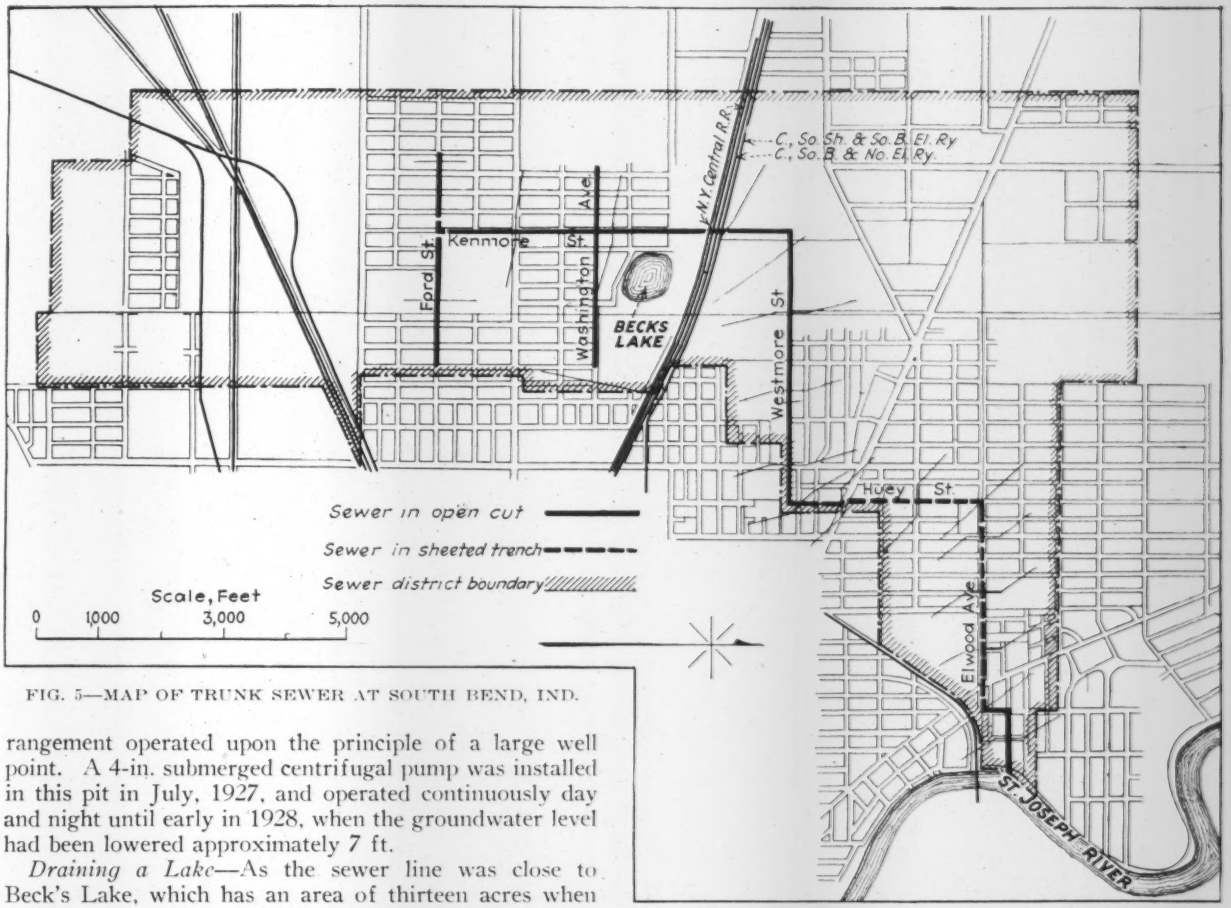


FIG. 5—MAP OF TRUNK SEWER AT SOUTH BEND, IND.

rangement operated upon the principle of a large well point. A 4-in. submerged centrifugal pump was installed in this pit in July, 1927, and operated continuously day and night until early in 1928, when the groundwater level had been lowered approximately 7 ft.

Draining a Lake—As the sewer line was close to Beck's Lake, which has an area of thirteen acres when full and contains 50 to 60 million gallons of water, it was considered desirable to drain this lake in advance in order to prevent seepage or flooding of the trench. A suction pipe supported on steel floats made from oil drums was extended to the middle of the lake and submerged in a rectangular pit provided with screens to exclude fish. A 10-in. horizontal centrifugal pump with a 100-hp. motor was placed on shore and delivered the water into a 2,800-ft. discharge pipe leading to a sewer. Operating 24 hours per day and delivering 4,000 g.p.m., the pump drained the lake in nine days. The State Department of Conservation transferred the greater part of the fish to neighboring lakes.

FIG. 6—DEEP OPEN CUT IN SAND AND GRAVEL
Drag-line machine with 3-yd. bucket is excavating to grade inside shield, and also lowers 80-in. pipe into place. Another drag-line machine follows as a backfiller.

As the draining of this lake lowered the water level in the surrounding territory it materially aided the sewer work. When pumping was stopped, the lake began to fill again, and after a heavy rainfall in January it was above its original level. It is considered that a serious error was made by the contractor in discontinuing pumping entirely, as considerable delay resulted from the removal of this new and larger volume of water. For this second drainage operation the pump was mounted on a scow at the middle of the lake and the suction pipe was dropped into the wooden sump box; the discharge line was supported by the floats which had previously carried the suction pipe.

Through the marsh lands beyond this lake a considerable amount of water was encountered, the sewer trench intercepting what was presumed to be an underground outlet for the lake. This spouted with great force for several hours, discharging approximately a 6-in. stream of water for a distance of more than 30 ft. across the trench.

Pipe-Laying Shield—In much of the open ditch work a shield or steel box (Fig. 6) was used by the contractor

in the bottom of the ditch to keep the fine water-bearing sand from running in while the pipes were being laid. The shield, made of ⅜-in. sheet steel, was 5 ft. in depth and approximately 9 ft. long. It was rectangular and varied in width according to the size of pipe for which it was used, each shield being 1 ft. wider than the outside diameter of the pipe. This permitted a 6-in. opening on each side of the pipe, which was blocked with timber. The shield was moved along the trench and lifted ahead by the excavating machine with a chain attachment. In most cases it was driven down into place with a steam hammer.

Engineers and Contractors—In March, 1927, the contract was awarded to the J. J. Dunnegan Construction Company, Shenandoah, Iowa. Its plant includes 3-yd. and 2-yd. dragline excavators with 100-hp. and 75-hp. oil engines, three trench excavators, a trench machine, three backfillers, two concrete mixers of 21-cu.ft. capacity and seven cranes. Construction was commenced in April, 1927, and is to be completed in July, 1928. The estimated cost was $1,700,000, but the actual cost to the city will be somewhat less than the estimate.

This trunk-sewer project was designed by the city engineering department, which is also supervising its construction. C. E. Williams, assistant engineer, is in charge of the field forces, under the direction of Raymond L. Pike, assistant city engineer in charge of sewers, South Bend, Ind.

Spillway of Boyds Corners Dam to Be Lowered

Precautionary Measure Adopted by New York City as Result of Safety Studies of Seven Old Dams in Croton Watershed

STUDIES of the safety of seven impounding dams built more than 25 years ago in the Croton watershed have resulted in steps being taken to lower by 15 ft. the spillway of the Boyds Corner Dam, a masonry-faced concrete structure, backed with earth, put in use in 1872, having a maximum height of 78 ft., an extreme water depth of 60 ft. and impounding a little over 2,700 m.g. of water. The work has been started as an emergency measure by John J. Dietz, commissioner of water supply, on recommendation of William W. Brush, chief engineer of the department. The estimated cost is $50,000 to $100,000. The emergency contract for the work has been let to the Culsher Contracting Company, New York City.

The dam was designed by George S. Greene. J. J. R. Croes was resident engineer. The dam was originally intended to have an overfall spillway in one end, but when near completion and after the change of control noted below, it was decided to back it with an earth fill, 20 ft. wide on top, at the level of the masonry dam, with a slope of 2½ to 1. This necessitated an independent spillway, which was provided beyond one end of the dam, by a rough excavation in rock. The earth fill, it appears, was of pervious material, dumped from carts, with no rolling or compression other than by the carts and horses.

Extracts from Mr. Brush's report of July 23, to Commissioner Dietz, follow:

A check-up of the older dams on the Croton watershed is being made, to determine the adequacy of these structures, both as to their strength and the capacity of their spillways to safely discharge maximum flood flows. There is no question about the adequacy of the large masonry dams and spillways that have been constructed during the past 25 years. In light of the present-day information as to the intensity of flood flows, such as occurred in Vermont last fall, it has seemed advisable to investigate those dams built prior to 1900, which, with the dates put in service, are: Boyds Corners, 1872; Middle Branch, 1878; East Branch, 1891; Bog Brook, 1891; West Branch, 1895; Amawalk, 1897; Titicus, 1893.

The first dam to be investigated is the Boyds Corners dam, which was selected for prior investigation due to its unusual design, present condition and past history. This dam is located in the town of Kent, Putnam County, and was the first dam to be constructed in the Croton watershed after the completion of the old Croton dam. The construction was started in 1866, and the reservoir was first filled in April, 1872. The dam is a masonry structure, built originally to hold the water without any earth backing, but before the dam was completed a large earth fill was placed on the upstream side of the dam, to increase the watertightness of the dam, as well as its stability. While the earth fill has undoubtedly reduced the leakage through the dam, such leakage has at all times been rather large. On the other hand, it is believed that the earth fill has increased the pressure against the masonry portion of the structure and decreased, instead of increased, its stability. An analysis shows that the dam cannot be depended upon to safely withstand the forces acting against it, due to the depth of water in the reservoir and the earth fill against the dam. The computations show that the spillway of the dam is inadequate to carry the maximum flood flow which might occur, and in an extreme flood the water would go over the top of the dam.

In my opinion, this reservoir is an unsafe structure in its present condition, and it is essential that the depth of water in the reservoir be reduced by lowering the spillway and waste channel level, so that the maximum depth of water in the reservoir will in the future be approximately 15 ft. less than the present maximum. From the viewpoint of safety, this work should be accomplished during the present summer and fall, as the maximum flood flows are usually experienced in the late fall, winter or spring months.

As a measure of precaution, on May 14 of this year instructions were given to lower the water level in the reservoir by opening the blowoff pipes, but on account of the unusually heavy rainfall, it is only within the last few days

LOCATION OF BULGE IN DAM

that the reservoir level has fallen below the spillway level. The blowoff pipes are unable to discharge the quantity of water that is delivered into the reservoir at times of even moderate flood flows.

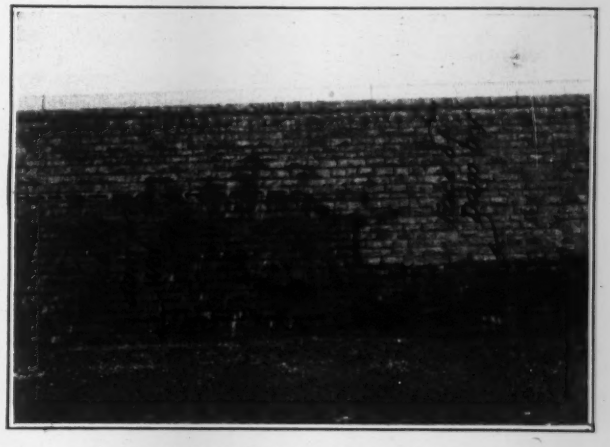
There is attached hereto a memorandum giving certain facts in relation to the construction of the Boyds Corners reservoir dam and showing the very slight effect that the lowering of the water in this reservoir would have on the available water from the Croton watershed.

MEMORANDUM

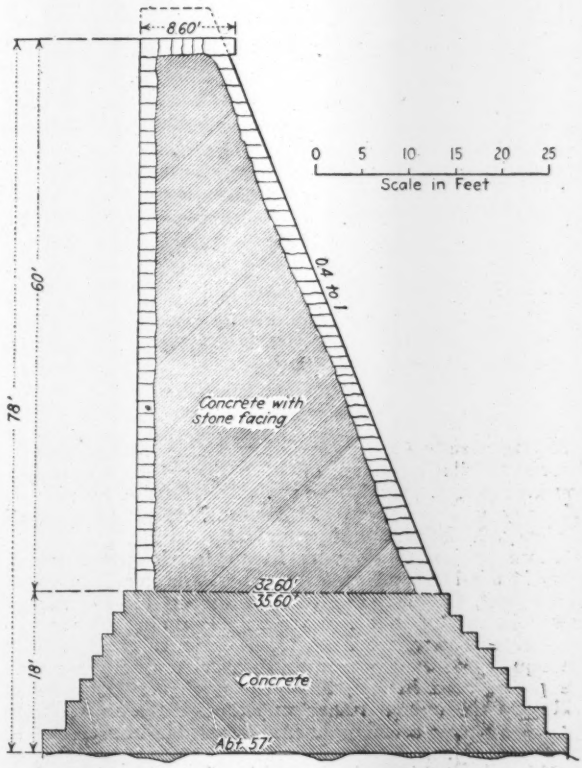
In 1866 the then Croton Aqueduct Board decided to build a reservoir at Boyds Corners on the West Branch of the Croton River, 23 miles from the old Croton dam, which, at that time, was the only dam in the Croton watershed. The dam was constructed of masonry, founded on rock and extending to rock on each side of the valley. It has a maximum height of 78 ft., with a width at the top of 8.6 ft. and at the base of 57 ft. The length of the dam across the valley is 670 ft. In 1870, when the dam was nearly completed, the control of the work was transferred to a Department of Public Works, which took the place of the earlier Croton Aqueduct Board. In the report of Edward H. Tracy, chief engineer of the Department of Public Works, dated April 24, 1871, the following statement appears in reference to the Boyds Corners reservoir. [Some information already given is omitted here.—EDITOR]:

" . . . The original design contemplated passing the floods over the top of the dam near its northern end. After a careful examination of the whole subject by this department, it was deemed unsafe to trust to this wall of masonry alone, and it was decided to build a substantial and watertight earth bank on the inner side of this wall and to cut a canal through the solid rock at the northern end of the dam of sufficient capacity to pass the water of floods around the dam, and allow it to flow over a natural rock surface into the river at some distance below the dam."

The earth bank was not watertight when the reservoir was first filled, early in 1872, as shown by the leakage of water appearing on the downstream face of the masonry dam, and since that time this leakage has been constantly present, although varying somewhat in amount. About 30 years ago a slight bulge or movement showed in the central part of the downstream face of the dam, but apparently since that time this bulge has not increased. The earth bank on the upstream side of the masonry dam is virtually saturated with water up to the height of water in the reservoir, and, in the judgment of the engineers of this bureau, the placing of the earth bank increased the thrust against the masonry portion of the dam and decreased its stability. Such a result was contrary to the intent of those responsible for placing the earth bank, and at the time this dam was built engineers raised the question as to its safety due to the pressure exerted by the earth bank, as shown by a paper presented by J. J. R. Croes to the American Society of Civil Engineers, under date of Nov. 4, 1874. Mr. Croes was one of the engineers in charge of the construction work on this dam. [The paper appeared in *Trans.* Am.Soc.C.E., Vol. 3, pp. 338-86 and was reprinted in *Engineering News*, April 8, 15 and 22, 1876, pp. 114, 122 and 130.—EDITOR.]



DETAIL OF BULGE IN BOYDS CORNER DAM
Surface is dry above and wet below bulge line.



OUTLINE SKETCH OF BOYDS CORNER DAM MASONRY
Large stones were placed in the concrete from bedrock up to about the level of the natural bed of the stream. After the masonry section shown was nearly completed, it was decided to place back of it an earth fill, with a 2½ to 1 slope, 20 ft. wide at its top, which was level with the masonry.

As far as it can now be determined, no steps were taken either to strengthen the dam or to reduce the pressure on the dam during the 56 years that it has been in use up to May 14 of this year, when orders were given to lower the water in the reservoir by opening up the gates that controlled the flow through the two blowoff pipes that carried the water from the reservoir to the stream below the dam. The unusual rains that occurred since May 14 have made it impossible to lower the water level back of the dam, and on July 13 the reservoir was full to the level of the spillway. If the rainfall is reduced in the future, the reservoir level will be lowered to a point that represents a safe depth of water, approximately 15 ft. below the present spillway level, and maintained at this level so long as possible. This level in the reservoir cannot, however, be maintained when the heavier runoff comes in the fall and winter.

The lowering of the water level of this reservoir will reduce the present storage capacity of about 2,700 m.g. by about one-half, and such reduction in storage will reduce the reasonably dependable yield from the Croton watershed, during the long drought periods, by about one million gallons a day or about one-third of 1 per cent of its present estimated dependable yield. While the dam might be reinforced and strengthened at an expense of about $200,000, it does not seem desirable for the city of New York to expend this sum of money on such work in view of the extremely small additional supply of water that would be secured thereby. While the lowering of the reservoir will temporarily expose relatively large areas that have previously been covered with water for the greater part of the time, these areas will be quickly covered with vegetation. The land immediately adjacent is owned by the city of New York.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Arc-Welded Water-Supply Lines

Sir—We have been interested in the account appearing on p. 101 of your July 19 issue featuring the welded steel pipe line now being laid from the Provo Mountain reservoir at Springfield, Mass.

You are slightly in error, however, in the prefatory editorial note to this article, in which you state that this Springfield line is the second large arc-welded pipe line to be constructed, the first one being the 90-mile long Mokelumne line in California. The attached double page reprint from your May 26, 1927, issue features the 60-in. arc-welded line fabricated by our associate, the Petroleum Iron Works Company, and laid by ourselves in Brooklyn for the Department of Water Supply, Gas and Electricity. But for the fact that this line is larger in diameter it is practically identical with the present Springfield line.

While the construction of our Brooklyn line did not begin until after the Mokelumne line was started, it was in service, I believe, before the California line.

Sharon, Pa., July 24, 1928. F. J. McDERMOTT, Penstock Construction Company.

Prevention of Scour Below Overfall Dams

Sir—The article by G. Gale Dixon, "Studies on Prevention of Scour Below Overfall Dams," in your issue of May 3 illustrates a hydraulic jump occurring on the steep face of a dam with no backwater or other external force to account for it. The author also calculates that a hydraulic jump should occur as shown.

It is impossible, under the conditions illustrated and described, for such a hydraulic jump to occur.

When water flows in thin sheets on steep slopes, the friction may in certain places exceed the channel slope, producing a series of waves that travel in approximately parallel lines downstream at right angles to the direction of flow. These waves, however, have nothing in common with the hydraulic jump, because the flow is all below critical depths.

This phenomenon is not apparent in the case of the Willwood dam cited by the author. J. C. STEVENS.

Portland, Ore., June 13, 1928.

Sir—Mr. Stevens' letter points an error, but his attendant statement is confusing.

The presence or absence of a hydraulic jump upon the face of the dam when discharging under shallow depth of overflow is not an essential element in the studies briefly outlined in the writer's article; it is, however, a point of technical interest.

The applicability of the Kutter formula to high-velocity flow at shallow depths rests upon very uncertain basis. The computations to estimate the friction of the falling sheet of water upon the face of the spillway in the writer's studies were therefore made under assumptions designed to result in error on the side of safety for the practical problem in hand. For shallow depths of overflow, this procedure resulted in indicating a "friction slope" steeper than the "channel slope"—in the terminology employed by Mr. Stevens—and suggested the necessity of occurrence of a hydraulic jump in order to stabilize the conditions of flow.

On p. 698 of *Engineering News-Record* of May 3, 1928, the writer stated with reference to the friction loss estimated with $n = 0.013$ in the Kutter formula that:

"It is interesting to note that on this basis of estimate a hydraulic jump should occur on the steeply sloping face of the spillway at a point about 17 ft. below the crest when discharging under a head of 1.3 ft."

A recomputation with refinements adapted to the specific question shows that the foregoing statement is not true and destroys the basis for the writer's tacit identification of the hydraulic jump as the cause of the "white water" which appears on the face of a spillway when discharging under such conditions. This sudden aeration of the water occurs at a substantially horizontal line on the face of smooth ogee overfall dams at distances below crest level which increase with the depth of overflow, until finally under heavy discharge it disappears altogether. It is to be observed on dams with profiles specially designed to avoid the formation of vacuum beneath the falling sheet under heavy discharge and with correspondingly less tendency toward vacuum to explain the aeration when the dam is discharging under shallow depths.

Mr. Stevens states:

"When water flows in thin sheets upon steep slopes, the friction slope may exceed the channel slope . . ."

This statement seems to require enlargement or qualification; in view of the topic under discussion, it appears to accept the thought that it is possible for a thin sheet of water flowing at high velocity down the face of a smooth overfall dam to develop a "friction slope" steeper than the "channel slope."

Flow of water "in thin sheets on steep slopes" infers flow at the lower alternative stage, which is the condition obtaining on the face of an overfall dam. The only change of stage possible, therefore, is a positive hydraulic jump to the upper alternative stage. Continuation of flow with friction slope steeper than the channel slope would result in the water reaching its critical depth and the formation of a hydraulic jump, as happens in the case of discharge from an orifice into a uniform open channel.

Youngstown, Ohio, June 28, 1928. G. GALE DIXON.

The Acre-Foot Is Best Storage Unit

Sir—Though the acre-foot is quite generally accepted as the unit of storage for power reservoirs, there are still some authors of engineering books and contributors to the technical press who seem loath to adopt it. Some reasons why the writer believes the acre-foot to be the most desirable unit are given in the following:

1. At the outset the reservoir area is measured, purchased, and the clearing is paid for, on an acreage basis.

2. The acre-foot is the most convenient unit in which to express the cost of a reservoir and to compare the cost of reservoir sites.

3. The irrigation engineer will continue to use the acre-foot so long as the foot-pound-second system of units continues in vogue; and it is desirable to use the same unit in both irrigation and power reports.

4. The transition from second-feet per 24 hours to acre-feet storage, for all practical purposes, requires only a multiplication by two.

5. One acre-foot of water falling 1 ft. will develop 1.024 theoretical kilowatt-hours, or 1.373 theoretical horsepower-hours of power. Or 1 acre-ft. falling 1 ft. at 70 per cent efficiency will develop 0.717 kw.-hr., or, at 65 per cent efficiency, 0.666 kw.-hr. of power.

Those having to do with hydro-electric power usually carry in mind (*a*) the capacity of the reservoir in thousands of acre-feet, (*b*) the power head in feet and (*c*) the value of power in mills per kilowatt-hour. Assuming 65 per cent over-all efficiency, we have this simple rule: Two-thirds the capacity of the reservoir in thousands of acre-feet, times the power head in feet, times the price per kilowatt-hour will give the annual return in dollars. By an additional step, also almost a mental one, it is possible to arrive at the capitalized value.

Of interest to those dealing with pulp and paper projects, it happens that if we assume 70 per cent over-all efficiency and 80 hp. continuously as the power required to make a ton of news paper in 24 hours, then 1 acre-ft. falling 1 ft. will make 1 lb. of newsprint. H. A. RANDS.

Sultan, Wash., June 20, 1928.

News of the Week

Request Permit for Toll Bridge Across Potomac

An application for permission to construct a toll bridge across the Potomac River at Great Falls has been filed with the War Department by the Great Falls Bridge Company, a corporation formed by a number of business and professional men of Washington, D. C., and vicinity. Funds have already been secured, and it is expected to begin construction work a short time after the granting of the permit. The bridge will be of steel and concrete and will cost about $1,000,000. A bill authorizing its construction, subject to the approval of the War Department, was passed at the last session of Congress. It is stated that the preliminary design has received the approval of the National Park and Planning Commission of Washington as being in harmony with the natural beauty of the falls, which was one of the aims of the engineer.

Move for Standardization of Building Plans

At a meeting of the Structural Engineers Society of New York held recently the following resolution was unanimously adopted:

Whereas, it is the desire of the Structural Steel Board of Trade to promote a better understanding among owners, architects and engineers so as to eliminate numerous losses and disputes arising out of the uncertainties in plans and specifications submitted for estimating and contracting purposes, thus reducing the cost of errors and increasing the efficiency of production and erection of structural steel; and

Whereas, the Structural Engineers of New York believe that it is desirable to further this condition; now therefore,

Be It Resolved, that the Society of Structural Engineers do hereby make the following recommendations:

1. That all plans be prepared according to the best engineering practice, showing all labor and material of the various classifications required and specifying the conditions under which the work is to be performed.

2. That all plans shall show a complete design with sizes, sections and relative location of the various members, with floor levels, column centers and offsets figured, and shall also show the character of the work to be performed with sufficient dimensions to permit of the making of an accurate estimate. Plans to be made to scale not less than $\frac{1}{8}$ in. to the foot and large enough to convey the information adequately.

3. That wind bracing and special details when required shall be shown in sufficient detail regarding rivets and construction to permit of an accurate estimate of the cost.

4. That specifications shall definitely enumerate all the items to be included in the estimate, and, in all respects not covered by the specifications, the code of standard practice of the American Institute of Steel Construction shall govern.

5. That inspection be called for in specifications under "Inspection." That amount of money to be included be specified, and that the inspector be appointed by the engineer.

The resolution was signed by F. A. Burdett, president, Laurence A. Ball, vice-president, and Elwyn E. Seelye, secretary of the Structural Engineers.

Foreign Engineers Interested in Mississippi Problem

Plans for the control of floods on the Mississippi are to be studied by engineers representing the Belgian Colonial Office, who are en route to this country for the purpose. The Belgian engineers hope to be able to apply some of the plans worked out on the Mississippi in connection with their efforts to control the Congo River.

Assurances recently were given the Italian government that engineers from that country would be welcome to inspect flood-control work now in progress on the Mississippi, and would be given access to all engineering data which have been gathered in that connection.

Queens Subway Tubes Holed Through

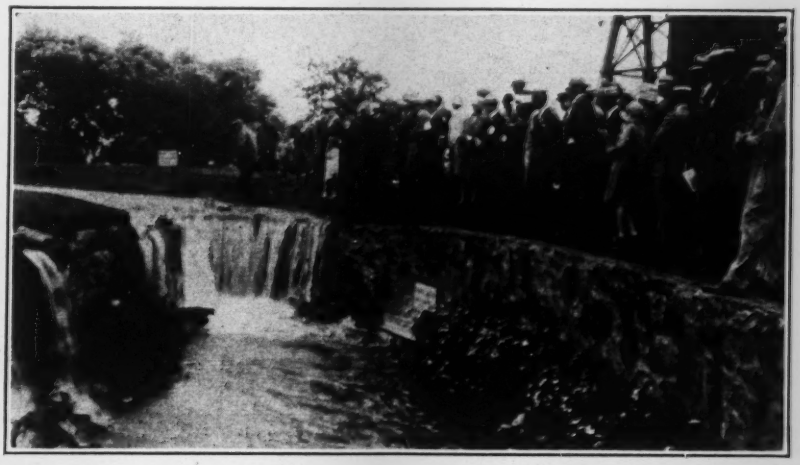
The twin tunnels under the East River connecting Welfare Island with the Borough of Queens, New York City, have been holed through six months ahead of schedule. The engineers estimate that the other section of this new extension to New York's subway system, which will connect Welfare Island with Manhattan, will be completed before the end of the year. Part of the tunnels under the main channel of the river lie above the normal river bed, and are protected by a heavy blanket of clay which has been dumped into place from barges. The men worked under a maximum air pressure of 35 lb. and were limited to a two-hour shift.

Stone & Webster Reorganizes

The Stone & Webster Engineering Corporation has been organized to take over from Stone & Webster, Inc., its construction and engineering business and its interest in Ulen & Company. The new company has also acquired McClellan & Junkersfield, Inc., the construction division of the North American Company. It has a capitalization of $9,500,000. G. O. Muhlfeld has been elected president.

This change leaves Stone & Webster, Inc., free to devote its entire efforts to the ownership and management of public utility companies, in which field it has already achieved prominence.

CIVIL ENGINEERS INSPECT MODEL OF NIAGARA FALLS



During the recent convention of the American Society of Civil Engineers at Buffalo, N. Y., members were taken to Niagara Falls, N. Y., to see a demonstration of the effect of submerged weirs upon the flow over a model of the Falls. The model is in the grounds of the Niagara Falls Power Company. It is built to a horizontal scale of 1 to 100 and a vertical of 1 to 25. Distribution of the flow over the crest and the quantities are proportioned to those actually running over Niagara Falls.

Indiana Building Congress Formed

An organization based on the building congresses now in existence in New York, Boston and a number of other cities has been recently formed in Indiana to act as a clearing house for the building industry and to harmonize the group activities of the Indiana Society of Architects, the Indiana chapter of the American Institute of Architects, the Associated Building Contractors of Indiana, the Indiana Engineering Society and a number of other organizations. As formed, the Indiana Building Congress represents about 36,000 men in the building industry of the state. Merritt Harrison, Indianapolis architect, is president, Charles E. Kern is vice-president, William Smith treasurer, and J. H. Owens executive secretary. The board of directors consists of Merritt Harrison, Charles E. Kern, Emmett Hall, G. F. Watson and William Smith.

Complaints Against Sewage-Works at Oklahoma City

Unpleasant conditions along Deep Fork Creek, below the northern sewage-works at Oklahoma City, Okla., with resulting complaints and prospective suits, are reported as due to the fact that these works consist of Imhoff tanks only, without the trickling filters recommended by the engineers. This part of the original design was omitted owing to lack of funds, as the citizens' committee, under whose direction the plans were made in 1926, decided that nothing more than the tanks could be financed at tht time. Deep Fork Creek is a relatively small stream, with very slight flow in the summer, so there was no question as to the need for more complete treatment, and the use of chlorine as a supplementary treatment during very dry weather was suggested, but the engineers advised against this plan. The effluent from Imhoff tanks is not stable and the only remedy for present conditions lies in the installation of filters, as stated by C. E. Bretz, superintendent and engineer of the city water department. The works were designed by Pearse, Greenly & Hansen, consulting engineers, Chicago, and were described in *Engineering News-Record* of June 16 and 23, 1927, pp. 978 and 1018.

Shand Retires From P.R.R.

A. C. Shand, assistant to the vice-president and for many years chief engineer of the Pennsylvania Railroad, retired from active duty under the railroad pension regulations on Aug. 1. He began work with the Pennsylvania in 1879 on construction and relocation work near Connellsville, Pa. In 1884 he was made supervisor of the Altoona yard and five years later assistant engineer of maintenance of way. In 1905 Mr. Shand became assistant chief engineer and less than a year later chief engineer with jurisdiction over lines east of Pittsburgh. On March 1, 1920, when the railroads were returned to private ownership, his responsibility was extended to cover the entire Pennsylvania system. On Feb. 1, 1927, Mr. Shand was promoted to the newly created position of assistant to the vice-president and was assigned to special engineering duties in connection with the new Philadelphia passenger station.

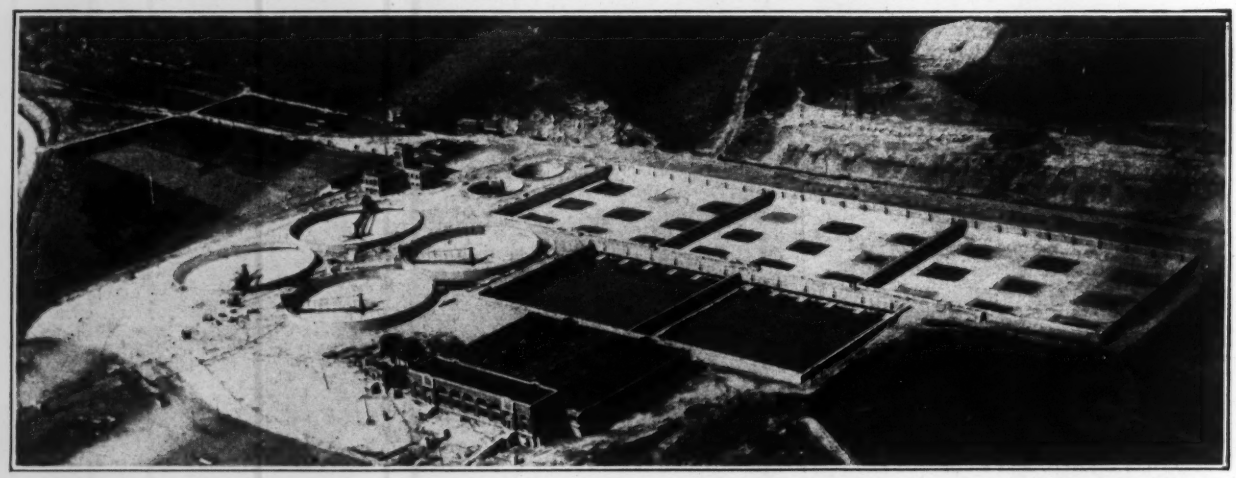
Permit Issued for Tennessee River Power Project

The Federal Power Commission, at a meeting on July 23 attended by Secretary Jardine and acting Secretary Finney, authorized the issuance of a preliminary permit to the Mississippi Power Company covering a proposed development on the Tennessee River at Cooks Landing. By creating an effective head of 41 ft. at that point, a reservoir extending 63 miles upstream to the base of the Muscle Shoals dam would be created. This would flood out the existing government lock, dam and canal at Colbert Shoals. The initial installation proposed is 100,000 hp., but plans provide for the ultimate installation of 260,000 hp. As the recent report of the engineers on the Tennessee River indicates that the interests of navigation would be served best by locating the dam at Pickwick Landing, 11 miles farther downstream, the preliminary permit contains a condition under which the power company must submit a complete engineering, economic and financial report on the Pickwick Landing site.

Buffalo Bond Issue Sold

Bonds to the amount of $8,550,000, the largest issue in the history of the city, have been sold by the city of Buffalo, N. Y. Part of the proceeds will be used for public-works improvements, including $480,000 for water-works, $150,000 for new bridges, $468,000 for improvements in Buffalo harbor and the Buffalo River, $600,000 for pavements, $50,000 for a sewage-disposal study and $200,000 for grade-crossing elimination.

NEW KANSAS CITY WATER PURIFICATION WORKS ON THE MISSOURI RIVER



At the new Kansas City water purification plant, raw water from the Missouri River is passed through three traveling screens of ⅜ in. mesh to four preliminary settling tanks (the large round tanks on the left of the picture) with a combined capacity of 16 m.g. These are equipped with Dorr clarifiers. Lime and alum are then added in the two small tanks (upper left center) of 2 m.g. combined capacity. The water and chemicals enter at the top, tangentially, and leave at the center of the bottom. After coagulation in the five basins of 51 m.g. combined capacity, the water is filtered through 24 rapid sand filters, and chlorine is finally added. The large building in the foreground of the picture contains the filter plant and secondary pumping station. Immediately to the left is the chlorine building and two wash-water tanks. Other chemicals are housed in the building to the extreme left. The higher tank in the background is a pressure tank connected with the city water system. The treated water is passed through a tunnel underneath the Missouri River to the pumping plant.

The new plant, already in partial operation, will be increased in output as certain necessary changes in the old distribution system are completed.

New York to Have 67-Story Office Building

Preliminary plans for the Reynolds Building, a 67-story office structure 808 ft. high to be erected in the Grand Central district of New York City, have been announced, and it is stated that the financing of the $14,000,000 structure is practically completed. The site selected is on Lexington Ave. between 42d and 43d Sts., and contains about 37,500 sq.ft. The building will contain 17,000 tons of steel and will have a rentable area of 900,000 sq.ft. It will be of the modern setback style of architecture, although the tower will rise directly from the Lexington Ave. front to its full height, departing from the usual design.

Municipal Problems to Be Studied by Institute

A one-week course of intensive study of the problems of the modern municipality is to be held at the University of Southern California at Los Angeles Aug. 13 to 18. Among the subjects to be treated by expert speakers are city planning, municipal finance, traffic control, public health, municipal engineering, social welfare, legal problems, public institutions, recreation, park administration and a number of others. The gathering, which is known as the Institute of Municipal Administration, will be attended by mayors, city managers, commissioners and citizens interested in municipal affairs.

Eufaula Toll Bridge Now Free

The toll bridge over the South Canadian River near Eufaula, Okla., is now open to traffic without charge as a result of a court injunction restraining the bridge company from collecting tolls pending a final hearing and accounting. As explained in *Engineering News-Record* of July 19, 1928, page 111, a contract between the bridge company and the state provides for the recapture of the bridge after the tolls have amounted to a sum sufficient to pay the agreed purchase price of $194,000 over and above certain expenses.

To Name Delegate to World Engineering Congress

The American Railway Engineering Association, through its board of direction, has accepted the invitation of the American Committee of the World Engineering Congress to appoint an official delegate to attend the congress in Tokyo, Japan, in October, 1929. To co-operate with the American committee the president of the A.R.E.A., by direction of the board, has appointed a committee consisting of D. J. Brumley, chief engineer, Chicago Terminal improvements, Illinois Central Railroad, chairman; G. J. Ray, chief engineer, Delaware, Lackawanna & Western Railway, vice-chairman; J. M. R. Fairbairn, chief engineer, Canadian Pacific Railway; Earl Stimson, chief engineer of maintenance, Baltimore & Ohio Railway; and W. C. Cushing, engineer of standards, Pennsylvania Railroad. W. D. Faucette and E. H. Fritch, president and secretary of the association, are ex-officio members of the committee.

Contract Let for Government Hospital in Louisiana

A general contract for the construction of sixteen buildings, together with roads, walks, grading and drainage at Pineville, La., has been awarded by the U. S. Veterans' Bureau to the N. P. Severin Company of Chicago for $1,027,675. The work is to be completed in 315 calendar days. Separate contracts will be let for the plumbing, heating and electrical work, and for elevators, refrigerators and ice-making machinery, and a concrete chimney. The total cost of the veterans' hospital will be approximately $2,500,000.

Two Railways Seek Extensions

Approval by the Interstate Commerce Commission has been recently requested for two proposed railway extensions. The St. Louis Southwestern (Cotton Belt) has applied for permission to purchase outright three small independent roads in Missouri and Arkansas: the Gideon & North Island, the Deering Southwestern and the Blytheville, Leachville & Arkansas Southern. Approval of the plan will lead to the construction of an 18-mile connection between Gideon, Mo., and Deering, Mo., and an 11-mile connection from Hornersville, Mo., to Leachville, Ark.

The proposal of the Pittsburgh, Lisbon & Western to build a new line connecting Youngstown, Ohio, with the Ohio River was recommended for approval to the commission by C. V. Burnside, assigned to investigate the project. The plan involves the building of 42 miles of new track at an estimated cost of $5,026,853.

Biloxi Bridge Contract Awarded

Bids were opened on July 12 for the construction of a highway bridge 1.48 miles long across Biloxi Bay, Miss. The contract has been awarded to the low bidder, the Fuller Construction Company of Memphis, Tenn., for $811,746.37, based on the engineers' estimate of quantities. The bridge will carry a 20-ft. roadway and one sidewalk. About 55,000 concrete piles will be driven, the maximum length being 90 ft.

Springfield Park Plan Killed by U. S. Opposition

A plan to create a park along the Connecticut River in Springfield, Mass., and at the same time make possible enlargement of central station and railroad facilities, was disapproved by the War Department on the ground that the proposed fill along the river bank would be an undue encroachment on the channel and would increase the flood hazard.

Brief News

THE SIMMESPORT BRIDGE across the Atchafala River at Simmesport, La., will be dedicated on Aug. 5. The bridge, which was described in *Engineering News-Record* Oct. 6, 1927, p. 540, is a combined railroad and highway structure built by the Louisiana Railway & Navigation Company. It was opened to railway traffic April 15 and to highway traffic June 27.

THE ACQUISITION of Honeoye Lake and the surrounding territory by the city of Rochester, N. Y., for water-supply purposes is being opposed by the board of supervisors of Ontario County, although the State of New York has already granted permission to proceed with the project.

THE 21,600-KW. HYDRO-ELECTRIC STATION of the Northern States Power Company at Chippewa Falls, Minn., went on the line with full load June 15, 2½ months in advance of the date originally scheduled for completion.

THE QUEBEC HARBOR BOARD has issued a new loan of $8,000,000 to be used in making extensive improvements to the harbor and terminal facilities. The first part of the project to be undertaken will be a 2,000,000 bushel addition to the grain elevator at that point.

THE VILLAGE OF MASSENA, N. Y., will purchase the water-distributing system of the St. Lawrence Water Company, including all water lines, mains and equipment within the village limits. The village will pay $185,000 for the system and is also planning an expenditure not exceeding $39,377 in enlarging and extending the water mains. The transaction will be financed by a bond issue to run for 30 years.

ELECTRIFICATION of the suburban service of the Pennsylvania Railroad between Philadelphia and Wilmington is progressing rapidly, and it is expected that regular train service will be inaugurated in the fall. A recent test run near Wilmington was completely successful.

A COMPLETE NEW PLANT costing $2,500,000 and including 1,000 ft. of docks and bulkheads, rock storage bins of 125,000-ton capacity, a large group of steel and brick buildings, a power house, roads, and railway trackage will be built on the Indiana Harbor Canal, in East Chicago, by the United States Gypsum Company. A general contract for the work has been let to the Turner Construction Company, of Chicago, Ill.

THE ROOSEVELT BRIDGE across the Little Missouri River, 17 miles from Watford City, N. D., has been completed at a cost of $100,000.

FOUNDATION WORK has been completed and steel erection begun on the new twelve-story office building of the Northern States Power Company in Minneapolis, Minn.

Washington Notes

By Paul Wooton, *Washington Correspondent*

Boulder Dam Commission Holds First Meeting — Flood-Control Progress—New Mooring Mast

ONE of the most important duties of the Boulder Dam Commission is to form a conclusion as to the extent to which earthquakes constitute a practical hazard to dams in the lower Colorado River. This opinion of W. J. Mead, professor of geology at Wisconsin State University and a member of the commission, was expressed after the initial meeting of the commission in Washington on July 30.

Little was done at this meeting other than organization. Major Gen. William L. Sibert, retired, was chosen by his fellow members to be chairman. Charles P. Berkey, one of the geologists on the commission, was elected secretary. Offices for the use of the commissioners were made available in the Bureau of Reclamation. It is expected that the commission will leave Washington on Aug. 15 for Denver, where a further study of existing engineering data will be made. After that the commission will visit the dam site. It is then expected that a further study will be made of records in Denver, after which the commission probably will return to Washington to formulate its conclusions and write its report.

Former Secretary Work, who appointed the Boulder Dam Commission on instructions from Congress, in remarks at the organization meeting indicated that he does not believe any further engineering study is necessary, but assured the members of the commission that officials of the department will be ready and willing to weigh any new evidence that the commission may unearth. The big question for the commission to decide, in Dr. Work's opinion, is whether or not it is feasible to construct such a dam under physical conditions such as exist in Boulder Canyon.

Roy O. West, the new Secretary of the Interior, assured the commission at its public session that every facility and resource of the Interior Department would be at its disposal. There is no agency in the government more anxious to see the Boulder dam question solved, and solved properly, than the Interior Department. Secretary West suggested that Dr. Elwood Mead, the Commissioner of Reclamation, could be of great help to the members of the commission because of the complete grasp he has of problems involved in this outstanding project.

To Push Levee Work

Rapid progress on the flood-control program on the Mississippi River may be expected from this time forward, Major Gen. Edgar Jadwin, Chief of Engineers, stated, on his return from a six weeks' trip down the river with Carleton W. Sturtevant and Brig. Gen. Thomas H. Jackson, who constitute the two other members of the board of three set up by the flood-control act.

For the purpose of studying those features of the engineering work in which the reports of the army engineers and the Mississippi River Commission are in conflict, the board held four formal hearings and a large number of informal conferences. The stenographic transcript of the testimony of nearly 100 witnesses covers more than 600 typewritten pages. In addition, there are 600 pages of exhibits.

Because of high water the work on the Mississippi has had to be curtailed to some extent during the early part of the summer. The stage of the river now is such that this work can go forward. General Jadwin explained that plant had been assembled at assigned points and all was in readiness at many places to begin work when the stage of the water would permit. Practically all levee contracts will have been let by Aug. 10. Some of the successful bidders will not be able to begin work until they have secured equipment, but those who were awarded the earlier contracts were able to begin operations in a remarkably short time after the bids were opened.

Members of the board declined to speculate on the length of time that will be required to bring in their report. A great deal of study is involved and in some cases the results of surveys must be awaited.

Mooring Mast Being Built

A new type of mooring mast is being built by the Bureau of Yards and Docks of the Navy Department at Lakehurst. It is of the mobile, telescopic type, capable of serving the Los Angeles and also the new 6,000,000-cu.ft. airship now under construction. It is unique in that provision is made for moving it from place to place, and the mast itself can be telescoped to reduce the height above ground by approximately 30 ft.

The mast will be of structural steel with a height, when extended, of 69 ft., which will eventually be increased to 80 ft. to serve the 6,000,000-cu.ft. airship. Each of the three legs of the mast will be supported on a set of two caterpillar wheels. The equipment will include two 25-kw. direct-current generators driven by gasoline engines which will furnish power for operating the winches, mast and movable platform, and for lighting. The mast will carry water and gasoline tanks for serving the airship. The weight of mast, wheels and equipment complete will be about 100 tons.

The mast will be moved by means of a tractor. A 20-ton tractor may be sufficient for this purpose, but extensive experiments will be conducted upon completion of the mast to determine how much motive power will be required. A 40-ton army tank is to be used for these experiments.

As this is the first structure of this kind ever attempted, it is in the nature of an experiment. The telescopic feature will permit bringing the airship to the ground level, the after part of the airship being supported on a wheel resting on the ground, thus permitting the ship to rotate at will about the mast. This design may eliminate the necessity for mooring the ship at a height of approximately 200 ft., as at present, and it is hoped will result in economy and ease of handling. Experiments will be carried on with the mast in taking the ships in and out of the hangar and it is hoped that this will greatly simplify this operation.

The idea of building a mast of this kind was conceived by officers attached to the lighter-than-air service of the navy, while the detailed plans were developed by the Bureau of Yards and Docks under the direction of Rear Admiral L. E. Gregory, Chief of Bureau. The estimated cost of the structure complete is approximately $60,000.

Personal Notes

Robert Ridgway, chief engineer of the New York City Board of Transportation, has been granted an indefinite leave of absence in order to take up his duties as member of the special board to investigate the possibilities of the Boulder dam project. John R. Slattery, deputy chief engineer, is filling the post left vacant by Mr. Ridgway.

Col. George M. Hoffman has been transferred from Fort DuPont, Delaware, to New York City for duty as district engineer. Colonel Hoffman is a former member of the Mississippi River Commission and was resident engineer of the Atlantic Division of the Panama Canal, in charge of the construction of the Gatun dam.

John P. Donovan, who has been divisional engineer for the Colorado State Highway Department in the Denver district, has been advanced to the post of maintenance engineer. Elzie E. Montgomery has been placed in charge of the Denver district. Robert Higgins is now superintendent of maintenance.

John C. Wilson, for four years a construction engineer in the bridge department of the division of highways of the State of California, has become associated with the bridge department of the State highway department at Austin, Tex.

Major C. S. Ridley has been transferred from the post of district engineer of the second San Francisco district to Fort DuPont, Delaware. Major E. H. Ropes, district engineer of the first San Francisco district, will assume the

supervision of the second district also. The district engineer of the second San Francisco district, in addition to supervising improvements of the Sacramento River, acts as secretary and dispersing officer for the California Débris Commission.

C. S. SLACK is now with the Syracuse (N. Y.) Grade Crossing Commission as assistant engineer in charge of field work. Until April of this year he was assistant engineer in charge of the preliminary survey for grade crossing elimination for the Delaware, Lackawanna & Western Railroad at Dover, N. J., and previously to that time was resident engineer for the Atlantic Coast Line in the construction of new lines in Florida.

WALTER A. PEIRCE, of Madison, Wis., has been appointed manager of the Racine water department, a municipally owned utility at Racine, Wis. Mr. Peirce has been in charge of the Nine Springs sewage-disposal project at Madison during the period of design and construction, previous to which time he was engaged in private practice as sanitary engineer and as city engineer for several Wisconsin cities.

J. W. BURT has been appointed division engineer of the Springfield division and the Indianapolis terminal of the Cleveland, Cincinnati, Chicago & St. Louis Railway, with offices at Indianapolis, Ind.

W. B. HODGE is now division engineer of the Chicago division of the Cleveland, Cincinnati, Chicago & St. Louis Railway, with headquarters at Indianapolis, Ind.

J. D. HUNTER, of the engineering department of the Colorado state highway commission, has been appointed city engineer of Carlsbad, N. M.

R. N. BERRYHILL, acting city manager of Tulare, Calif., for several months, has been officially appointed to the position by the city council.

EDWIN A. INGHAM, formerly engaged in contracting work in the San Francisco Bay region, has been appointed city manager and engineer of Coronado, Calif.

LINDEN V. FISHER has recently resigned from the Kentucky State Highway Department to accept a position in the designing and engineering department of the Bethlehem Steel Company at Bethlehem, Pa. Mr. Fisher is a graduate of Pennsylvania State College and for the past two years has been a bridge designer with the Kentucky Highway department. Prior to that he was assistant contracting engineer with the Virginia Bridge & Iron Company at Memphis, Tenn.

DANIEL R. GOMEZ, who has been in Argentina as construction engineer for the Selden-Breck Construction Company, of St. Louis, Mo., is now designing engineer for the Missouri State Highway Department, in Division 10, located in Sikeston. Mr. Gomez was previously with the Missouri Highway Department, and prior to that, after his graduation from the University of Texas, he was with the Cortez Oil Corporation doing general surveying and construction work in the oil fields of Tampico, Mexico.

GEORGE S. LEVERING, for seven years connected with the Consolidated Water Company, of Utica, N. Y., has recently been appointed engineer in charge of distribution in the Bureau of Water of Philadelphia, Pa. Mr. Levering in 1917 was acting chief engineer of the Consolidated company in Utica.

H. E. BEARD, acting chief engineer of the Kansas City, Mexico & Orient Railway, has been appointed chief engineer, with office at Wichita, Kan.

JOSIAH F. PINSON, division engineer of the Chicago, Milwaukee, St. Paul & Pacific Railway, has been appointed assistant engineer of maintenance-of-way, with office at Seattle, Wash.

W. G. JENS, formerly acting manager of the Pittsburgh office of the Byllesby Engineering & Management Corporation, has been made manager of that office.

Engineering Societies

CALENDAR

ANNUAL MEETINGS

AMERICAN WATER WORKS ASSOCIATION, Central Section, Pittsburgh, Pa.; Annual Meeting, Huntington, W. Va., Aug. 23-24.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Montreal, Canada, Sept. 18-21.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Convention, Detroit, Mich., Oct. 22-28.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Fall Meeting, San Diego, Calif., Oct. 3-5.

THE JACKSONVILLE (FLA.) ENGINEERS CLUB will hold an open meeting on Aug. 14, at which Judge Frank Upchurch, of St. Augustine, will speak on the city manager form of government.

Obituary

GARRETT DAVIS, a retired railroad engineer of long experience, residing at Kansas City, Mo., died recently while on a trip in Canada. Mr. Davis was born at Riverside, Iowa, in August, 1855, and left school in 1873 to join a locating party on the Cincinnati Southern Railway. He became assistant engineer on that road in 1875, and in 1877 went to the Burlington, Cedar Rapids & Northern Railway (now a part of the Chicago, Rock Island & Pacific system) as assistant engineer in charge of 12 miles of construction. In 1878 he was made roadmaster and held this position until 1894, when he was appointed division engineer, and in 1899 became assistant chief engineer. With the change in ownership of the line he was appointed division engineer of the Chicago, Rock Island & Pacific Railway in 1902 and was then successively made division superintendent in 1906, division engineer in 1914, engineer on valuation work in 1915, locating engineer in 1918 and division engineer again in 1920. Mr. Davis retired from service in 1925. He was a member of the American Railway Engineering Association, the Western Society of Engineers and the Roadmasters and Maintenance-of-Way Association.

JOHN CHESTER RALSTON, well-known consulting engineer and former city engineer of Spokane, Wash., died in that city on July 14 at the age of 64. Mr. Ralston began a varied engineering career with the U. S. Engineer Corps on the Missouri River in 1882, later being transferred to harbor work near Washington, D. C. In 1888 he entered the engineering department of the Union Pacific Railroad and was engaged in railway location and water-power development in various parts of the West. Later he was engineer on the steel erection of buildings, manufacturing plants and elevated railways in Chicago, including part of the original downtown loop of the Lake St. Elevated Railway. As a consulting engineer Mr. Ralston did much work in mining and irrigation, and acted for several years as president of the Pacific Coast Pipe Company. From 1907 to 1909 he was city engineer for Spokane, Wash., and supervised the construction of public improvements valued at more than $8,000,000. He was a member of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the Spokane Engineering Society and the Seattle Engineering Society.

WILLIAM EVANS GUY, 83, retired mining and civil engineer, died on July 23 at Cooperstown, N. Y. After studying at Miami University, Princeton, Heidelberg, Paris, the Freiberg School of Mines and the Cincinnati School of Law Mr. Guy settled in the Middle West, where he organized and directed many manufacturing and railway enterprises. He was connected at various times with the St. Louis & Eastern, the St. Louis, Peoria & Northern, the St. Louis Valley, and the St. Louis & Gulf railways, as well as the Madison Coal Company and a number of iron works. He was a veteran of the Civil War.

HANS DETLOF KREY, widely known German hydraulic expert, died July 22 at the age of 62. He had long been in charge of the government hydraulic laboratory in Charlottenburg, and for the past two years had been developing a new laboratory on a larger scale near Potsdam. Dr. Krey was noted for his ready co-operation with American engineering students in Germany.

Construction Equipment and Materials

Contractor to Use Belt Conveyor on Hudson River Bridge Pier

Concrete and concreting materials for the New York anchorage of the Hudson River suspension bridge will be handled by belt conveyors, according to the Conveying Weigher Company, Passaic, N. J., which has been awarded the contract for the belt conveyors by Arthur McMullen, Inc., New York City contractor. The system will use approximately 1 mile of belting made by the Manhattan Rubber Company, also of Passaic. The plan to be followed is for barge delivery of material. Portable conveyors will unload the sand, the gravel and bags of cement from the barges. The sand and gravel supply will be stored in bins at the dock, from which belt conveyors will carry them to the concrete mixers 1,000 ft. away. The cement bags will also be carried by belt conveyor up the inclined bank to storage near the concrete mixers. And finally the concrete will be delivered to the forms by belt conveyors. The belts are made of duck and rubber. The manufacturers claim that the system will be more automatic than the one at the Wanaque dam in New Jersey, which it also designed. Among the other conveying systems the Conveying Weigher Company has recently designed and supplied are those on the Conowingo dam on the Susquehanna River, and at the New Haven waterworks dam at North Branford, Conn.

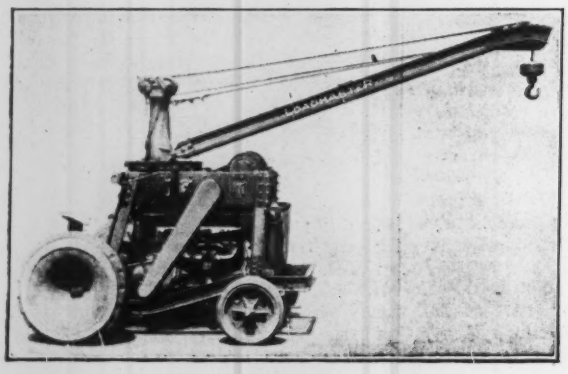
New Developments

Small Power Crane Mounted on Industrial Tractor

For handling loads which are too small to justify the installation of large crane units or which, by reason of their location, are not within reach of ordinary hoist service, Frederic H. Poor, Inc., 50 Church St., New York City, has developed a small crane mounted upon an industrial tractor. Power for lifting and swinging is obtained from the power take-off of the tractor.

To provide stability and sturdiness, specially weighted wheels with extra broad tires are employed on both the rear and the front. The frame consists of fabricated plate and channel sections, secured at the rear to the axle-housing and suspended at the front to compensate for irregularities in the floor or roadbed. Adjustable telescoping outriggers are available if required.

A self-locking worm-gear holds the load in suspension on the boom without the use of a friction brake. The full swing of the boom under load is approximately 120 deg. either side of the forward position. All controls are within easy reach of the operator. On a side swing the crane has a capacity of 1,000 lb. at a radius of 6 ft. 3 in., and 1,800 lb. at a radius of 5 ft. 6 in. On a forward swing the respective capacities at the above radii are 2,400 lb. and 3,000 lb.



Three New Road Graders for Light and Medium Duty

Three new road graders have recently been brought out by the Austin-Western Road Machinery Company, Chicago. Each model is regularly equipped with an 8-ft. blade, and two are light enough in weight to fall within the patrol grader class. The third is heavy enough to operate behind all but the most powerful tractors.

Model No. 12 is the lightest of the group and can be handled by two horses on all kinds of work. The draft beams through which power is transmitted to the blade are 4 in. deep. A heavy 5-in. circle channel section forms the 41-in. diameter, while the connection between the ends of the circle is the heaviest 8-in. channel section available. The spokes of the wheels are hot riveted into both the hubs and the rims, eliminating any possibility of their working loose. The removable sleeve between the axle and the wheel box forms the bearing and takes all the wear. The sleeve has a square opening so that when one side of the sleeve becomes worn, it can be turned to present a new surface to the box. With the addition of a tight-fitting dust cap, the company believes it has developed the best plain bearing wheel possible. The No. 12 grader weighs from 1,200 to 1,350 lb.

Model No. 22 is claimed to be the first patrol grader to be built with leaning wheels and telescopic rear axle. Its design and construction make it suitable for light grading as well as for patrol maintenance. Although the wheels are regularly fitted with plain bearings, the manufacturers recommend Timken tapered roller bearings, which they are prepared to furnish when ordered. Each rear wheel can be extended 11 in. from the closed position and both wheels have a separate control. It is said that six horses can handle the grader, although it is sturdy enough to work behind a light tractor. The grader weighs 2,200 lb. with horse hitch, 2,500 lb. with the tractor hitch.

Model 55 is a heavy duty grader built to work behind tractors of 40 hp. or less. Its arched frame is built exceedingly strong, and in addition is said to provide an unusual amount of blade clearance. The operator's platform is only 21 in. from the ground. The frame can be shifted on the rear axle a distance of 30 in., while the axle can be pivoted as much as 20 deg. to resist the side pressure of the dirt on the blade. Both front and rear wheels have 6-in. concave tires. This grader is regularly fitted with Timken tapered roller bearings in all four wheels. The blade raising worms and worm gears are of cut steel running in grease in dustproof housings. The grader weighs 5,500 lb.

All models of graders are hot riveted throughout, which the manufacturer points out as an unusual improvement over bolted assemblies.

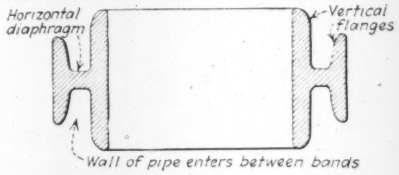
Cast Steel Sleeve for Pipe Piles Watertight Without Calking

A new driving sleeve for use in driving or jacking steel pipe piles has been developed by the Altmer Steel Products Company, and is being distributed in the United States and Canada by the Marine Metal & Supply Company, 167 South

St., New York City. The outstanding feature of the sleeve is that it provides a watertight pile, the joints becoming tighter as the hammering and pounding from driving the pile expands the pipe into the sleeve. Pipes from 8 to 20 in. in diameter may be successfully driven by the use of these sleeves.

The "bulb-lock" sleeve consists of a pair of vertical flanges or bands joined

by a horizontal diaphragm or anvil with concave and convex surfaces on the top and bottom respectively. The walls of the pipe enter the sleeve between these vertical flanges, and the ends of the pipe rest on the horizontal diaphragm. During driving the ends of the pipe upset against the vertical bands and bed themselves into the concave and convex



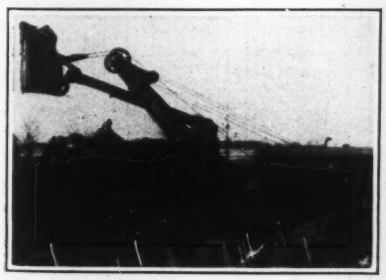
surfaces of the diaphragm forming the watertight joint. It is claimed that with the use of these sleeves, pipe has been driven down to 60 ft. penetration without the use of any calking material, and found absolutely watertight.

New Material-Hoisting Tower of Structural Steel

A steel tower for use in hoisting building material and concrete has recently been developed by the Insley Mfg. Company, Indianapolis, Ind. The tower is made entirely of structural members, the corner posts being angles 6 ft. 8 in. long, and can be easily set by hand, the diagonals and horizontals being lighter angles held in place by one bolt at each end. It is said that no single piece of tower with the exception of the top sheave beam assembly weighs more than 70 lb. This builder's tower is made in two sizes for use with a two-wheelbarrow or three-wheelbarrow elevator. It is made as a single- or double-compartment tower, and can be placed to any required height up to 600 ft. For hoisting concrete, a detachable bucket is mounted on the material elevator platform and is dumped by a switch located on the tower hopper. All sheaves are of the roller-bearing type.

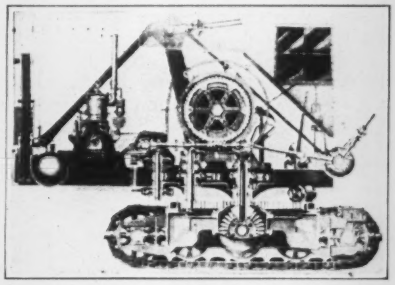
Hydraulic Control Features 1-Yd. Gasoline Power Shovel

The application of a hydraulic system of control for the main functions, crowding, hoisting and traction, is an important development in power shovel design that has been incorporated in a new 1-yd. shovel manufactured by the Austin Machinery Corporation, Muskegon, Mich., and known as the "Wolverine" model. The shovel is interchangeable for crane, clamshell, dragline and pull-shovel work. One type of hoist



is supplied for shovel work alone, while another type permits quick raising or lowering of the boom and is particularly adapted for crane service. The use of the hydraulic system is claimed to result in easy control that gives longer life to the machinery as well as speed and untiring operation.

In the hydraulic system, a triplex plunger pump circulates oil under a working pressure of 125 lb. per sq.in., this pressure being maintained by an accumulator, both the pump and accumulator being shown at the rear of the accompanying cross section illustration. Three-way valves with single lever operation control the hydraulic rams which operate the clutches. The



lever throw is short and it is claimed that the operator can feel the clutch action the same as with hand operation.

Twin drums are used with a worm-driven gear drive mounted between. There are only two gears below the upper frame, and all gears are housed and operated in an oil bath. The crowd is gear and shaft driven. The clutches are lined with non-burn asbestos metallic friction blocks. The crowd mechanism is mounted in a steel casting on the boom. The crowd control permits raising the dipper above and beyond the end of the boom. The racks on the dipper stick are sectional and made of manganese steel.

Both the lower and upper frame members of the machine are one-piece steel castings and structural steel members are used for the supporting platform. The ring gear is of the inside floating type, operating on spring-actuated plungers. On the crawlers a large oil reservoir at the hub of each idler roller provides lubrication over long periods. The crawlers are driven from the lower traction shaft by chain drive. A 6-cylinder 90-hp. Climax gasoline engine supplies the power. This engine is claimed to be the largest power unit supplied on a 1-yd. shovel.

Manufacturers and Trade Associations

CALENDAR

ANNUAL MEETINGS

TRACK SUPPLY ASSOCIATION, Chicago; annual exhibition and convention, Detroit, Sept. 18-20, 1928.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; semi-annual meeting, Buckwood Inn, Shawnee-on-Delaware, Pa., October 1-3, 1928.

New Publications

Surveying Instruments.—KERN COMPANY, 136 Liberty St., New York, N. Y., has published a new folder PJ-1, giving an outline of its various types of surveying instruments. In addition to the new catalog, the company has for distribution a reprint of a paper which W. R. Kern read before the Washington Society of Engineers entitled "What the Engineer Should Know About Surveying Instruments." The booklet is illustrated and gives such information as classifications, principles of construction, and types of materials and workmanship which make first class instruments.

Bucket Loaders—GEORGE HAISS MFG. COMPANY INC., New York City, has published a new 7-page catalog No. 328 describing its Model 16 bucket loader, with a capacity of one cu.yd. per minute. Complete specifications are given for the loader which is described as a medium-duty loader for stock pile service. Equipment for the loader such as swivel chutes and volume and weight batching hoppers are also described.

Bituminous Pavements — BARRETT COMPANY, New York City, has recently published a 50-page booklet entitled "Maintaining Roads With Tarvia." By means of photographs and text the booklet takes up in order the use of Tarvia on gravel roads, macadam roads, concrete pavements, wood block pavements, brick pavements, cobblestone pavements and stone block pavements. For each of these several methods of repair work are pointed out. In addition, information is given on methods of resurfacing, on the laying of Tarvia pavement and on the practice of widening other pavement with Tarvia shoulders.

Mixers—JAEGER MACHINE CO., Columbus, Ohio, has published a 40-page catalog No. T-28, describing its tilting-type mixers. Illustrations are given of the various models, and also of the important machine details, such as water measuring tanks, special wheels, batch counters, drums and automatic skip shakers.

Lubrication—DOT LUBRICATION DIVISION, CARR FASTENER COMPANY, Cambridge, Mass., devotes a 15-page catalog to the use of its lubricating system of guns and nipples for industrial machinery. The booklet contains illustrations and descriptions of the various types of guns and grease-fillers, and tables and illustrations of all types of nipples, elbows, bushings and other fittings. On one page is given a list of the various companies, both manufacturers and users, whose equipment is supplied with Dot lubricating systems.

Car Dumpers—ROBERTS & SCHAEFER COMPANY, Chicago, devotes a new bulletin No. 103 to its rotary car dumpers. Illustrations and descriptions show the use of these car dumpers in mines and quarries.

The Business Side of Construction

July Contracts 6 Per Cent More Than a Year Ago

THE July value of engineering construction contracts, 6 per cent greater than a year ago, pushes the total for the first seven months of 1928 over the two billion dollar mark, compared with one and three-quarter billions for the same period of 1927. This is an increase of 17 per cent and is reflected in both private and public work. The outstanding gain is in commercial and institutional building contracts, with $1,126,000,000, compared with $895,000,000 in 1927, and in road contracts, $325,000,000, compared with $282,000,000 last year. Industrial buildings, an important indicator of business confidence, are 12 per cent ahead of last year. The figures for water-works and bridges are almost identical with those of 1927. Miscellaneous projects show a decline, as do sewers and excavations. The increase is most pronounced in the Middle Atlantic states, although there is sound growth also in the South and Middle West. Construction in New England is about the same as a year ago, while there is a slight falling off between the Mississippi and the Pacific Coast.

The July figures are $256,000,000 in 1928 and $241,000,000 in 1927. The gain is principally in commercial building, with waterworks, bridges and roads well ahead of July, 1927. Industrial buildings and sewers show a drop, which is rather pronounced in the case of contracts for unclassified projects. Geographically the volume of lettings in July is distributed in the same proportion as for the seven months. The value of Canadian contracts is well above last year's value for both July and the seven months.

Value of residential contracts awarded for the first half of 1928 totaled $1,670,000,000, which is a gain of $242,000,000 over that period of 1927.

New capital issues, including stock and bonds, less refunding bonds, total $2,914,000,000 for the first six months of 1928, compared with $2,815,000,000 for the same period of 1927. This is the money that finances construction. As there is a lag of several months between financing and contract letting, it is significant that the whole gain in capital issues was in the second quarter. Both January and February were considerably under the figures for those months of 1927. The April-June, 1928, issues total $1,713,000,000, compared with $1,374,000,000 a year ago—a gain of 25 per cent. Thus it is reasonable to expect, with this additional capital available, that the lead in contract letting in 1928 not only will be maintained in the third quarter but will actually be increased as well.

Only New Municipal Bond Issues Find Present Favor

Municipal bond prices, as with bond prices generally, have been declining since the first of the year, the depreciation amounting to about 5 per cent. Despite this tendency, however, most of the bonds awarded in the last few weeks have been disposed of readily. This does not mean that new issues are cordially received, but that they can be handled with less effort, or greater profit, than the old ones, which in certain cases have been shelved. This dullness is a natural reflection of the continual raising of the Federal Reserve rediscount rate. The average rate has increased from 3.58 in January to 4.48 in June, a matter of 25 per cent. The raising of the New York rate from 4½ per cent to 5 per cent on July 13 should mean a continuance of low bond prices, at least during the next few weeks.

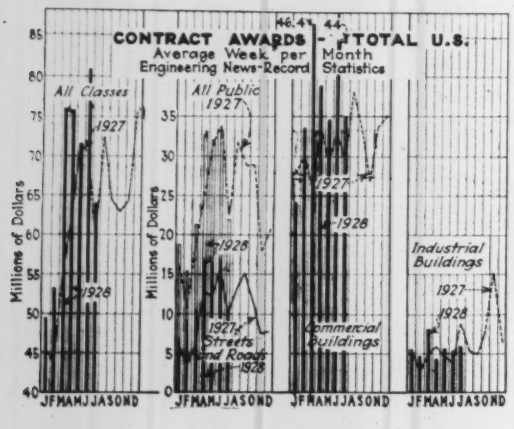
Municipal bond issues in the first half of 1928 are valued at $771,500,000, compared with $838,700,000 in the first half of 1927. The falling off has been entirely in the last two months of the half year, May and June when the drop was $101,600,000.

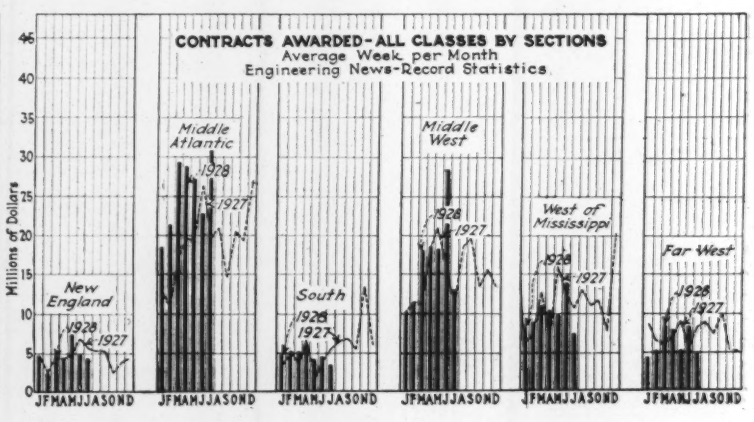
That the market is not dead, however, is indicated by current activity. This week each of half dozen issues to be marketed will amount to $1,000,000 or more, the largest being the $2,500,000 Nassau County (N. Y.) highway, hospital and buildings 4¼s. Cleveland School District offers $1,500,000 4s, and the city of Cleveland an issue of $1,879,000 improvements. Houston School District offers $1,047,000 bonds at interest

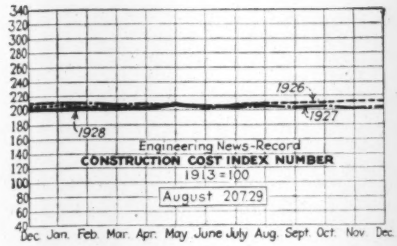
VALUE OF CONTRACTS BY SECTIONS IN THE UNITED STATES AND TOTAL FOR CANADA, JULY, 1928

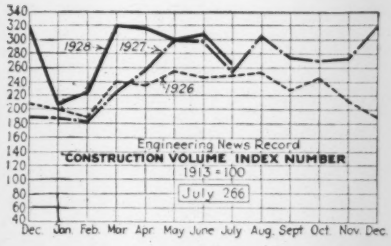
Thousands of dollars (-000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to Date, U. S.	Canada
Waterworks	$2,281	$1,156	$278	$807	$352	$293	$4,967	**$33,770**	.....
Sewers	145	1,568	182	1,703	527	738	4,863	**56,269**	$105
Bridges	3,515	906	409	2,546	561	197	6,884	**55,639**	500
Excavations, drainage, etc.	39	227	200	225	169	196	1,056	**16,365**	1,152
Streets and roads	3,107	10,774	5,380	9,564	9,066	4,812	42,703	**375,226**	2,071
Industrial buildings	1,250	7,430	3,870	9,245	1,125	1,089	24,009	**170,303**	2,155
Commercial buildings	6,496	94,317	2,112	26,935	17,627	10,477	157,964	**1,126,690**	8,682
Federal government	4	606	409	638	363	1,468	3,488	**28,289**	.....
Unclassified	194	6,374	167	164	992	1,040	8,931	**164,092**	343
July, 1928	17,031	123,358	13,007	51,827	30,782	20,110	256,115	.....	15,008
June, 1928	19,316	91,129	17,565	109,171	54,088	32,085	323,354	.....	12,496
July, 1927	22,007	78,092	21,990	43,806	42,047	32,708	240,650	.....	5,849
Year to date, 1928	**138,818**	**766,994**	**140,301**	**499,889**	**296,039**	**188,010**	.....	**2,030,051**	**91,555**
Year to date, 1927	142,079	541,210	125,461	422,835	310,784	213,260	1,755,629	.....	63,188









ENGINEERING NEWS-RECORD CONSTRUCTION COST AND VOLUME INDEX NUMBERS

not to exceed 5 per cent, as part of the $4,000,000 issue authorized last May. On Aug. 7 Los Angeles sold $6,500,000 water and power plant bonds, of which $1,500,000 are 4½s and the remainder will have a rate not exceeding 5 per cent. Rensselaer County, New York, receives bids Aug. 9 for a $485,000 highway issue, 5 per cent. Multnomah County, Oregon, which includes Portland, will be in the market Aug. 17 with an issue of $200,000 4½s.

The sale of $10,000,000 Chicago Sanitary District twenty-year 4¼ per cent bonds has been set for Aug. 16. This will be the third financing done by the district this year; the last sale was an issue of $11,000,000 4½s on May 3, which brought a price of 100.593, and the previous sale of like amount and interest was bid in at 101.07. The bonds are quoted at par in the open market.

One of the high spots of last week was the purchase and sale in a single day of an issue of $1,100,000 Richmond 4½s with less than a point in price separating the first and last bids of the nine competing syndicates.

In reading of these activities the statement made in the first paragraph must not be forgotten. The market for municipal bonds is unusually dull. Dealers are becoming increasingly reluctant to pay even current levels for new issues, and it is quite possible that some issues scheduled for award in the near future may fail to elicit bids because of the low rate and the requirement that at least par be paid.

In addition to summer dullness, not only in the municipal but in the general investment market also, and an apathy on the part of investors, high money rates make it burdensome for dealers to carry large inventories. Hence bids for new issues are at levels that will make the reoffering so attractive as to sell it immediately. This happened in the case of the recent State of Illinois sale. The size of the issue is a market factor, too. An issue of $1,000,000 or $2,000,000 may easily be absorbed, whereas an issue six times that size might drag unless very attractively priced.

Construction Cost and Volume Index Numbers

Engineering News-Record Construction Cost Index Number is 207.29, or only 0.64 point higher than July 1 and 1.79 higher than a year ago.

The Construction Volume Index Number is 14 per cent less than for June (the fourth highest month) but 6 per cent above the figure for July, 1927.

Monthly figures for the years 1927 and 1928 follow:

E. N.-R. Cost Index		E. N.-R. Volume Index	
August, 1928	**207.29**	**July, 1928**	**266**
July, 1928	206.65	June, 1928	308
August, 1927	205.50	July, 1927	252
Peak June, 1920	273.80	1927 (average)	263
1927 (average)	206.24	1926 (average)	228
1913 (average)	100.00		
1927		**1927**	
January	211.50	January	187
February	210.15	February	182
March	208.80	March	226
April	209.00	April	257
May	206.80	May	299
June	205.55	June	297
July	203.68	July	252
August	205.50	August	306
September	203.60	September	273
October	204.40	October	269
November	201.98	November	272
December	203.90	December	319
1928		**1928**	
January	203.90	January	208
February	204.65	February	225
March	204.65	March	318
April	206.40	April	316
May	207.00	May	299
June	206.15	June	308

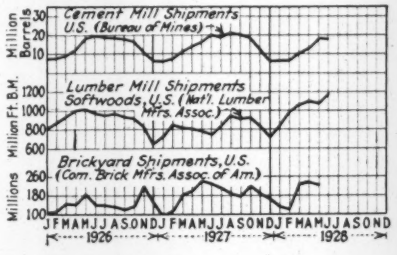
No Strikes in Building Industry; Agreements Reached

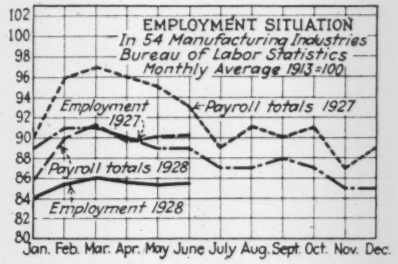
There were no strikes in July, nor were there any important wage controversies. In May there were eleven strikes, in June five, and in June, 1927, five. It will be interesting to see whether or not this unusual quiet portends any wage cuts. Although no industry has cut wages recently, general employment and payroll figures show declines from last year of 5.4 and 6.9 per cent.

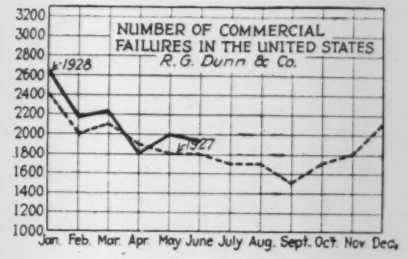
The five-day week in St. Louis is meeting with opposition from bricklayers, stone masons, steam fitters, hoisting engineers and building laborers. The objection is that the shorter week reduces working time by 12½ per cent, or from 200 days to 175. All St. Louis crafts are on the five-day schedule. Union plumbers, who recently had their weekly earnings reduced $6 through the adoption of the five-day week, have received an increase of 50c. per day to $12.50, effective July 1, 1928.

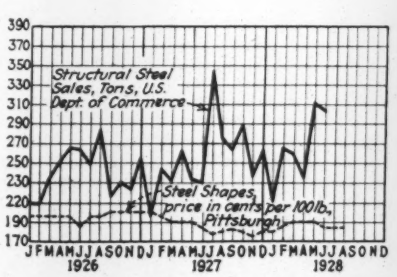
Important agreements reached during the last six weeks between employers and building trades mechanics are:

Bricklayers and plasterers of Asheville, N. C., accepted a wage reduction


Cement Mill Shipments U.S. (Bureau of Mines)
Million Barrels
Lumber Mill Shipments Softwoods, U.S. (Nat'l. Lumber Mfrs. Assoc.)
Million Ft. B.M.
Brickyard Shipments, U.S. (Com. Brick Mfrs. Assoc. of Am.)
Millions
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928






Structural Steel Sales, Tons, U.S. Dept. of Commerce
Steel Shapes, price in cents per 100 lb., Pittsburgh
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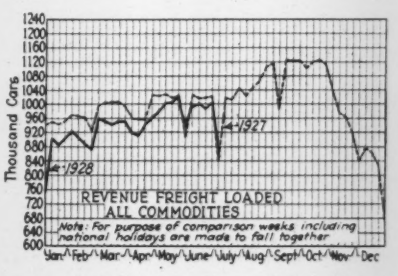
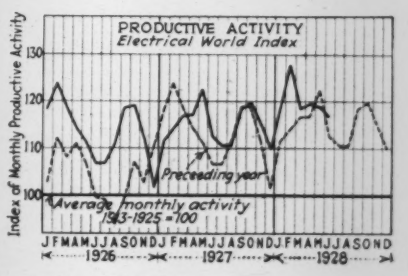
1926 1927 1928


Thousand Cars
1927
1928
REVENUE FREIGHT LOADED ALL COMMODITIES
Note: For purpose of comparison weeks including national holidays are made to fall together
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.


PRODUCTIVE ACTIVITY
Electrical World Index
Index of Monthly Productive Activity
Preceding year
Average monthly activity 1923-1925=100
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1926 1927 1928

MOVEMENT OF MATERIALS—EMPLOYMENT OF LABOR—ELECTRICAL ENERGY CONSUMED

CURRENT BUILDING TRADES WAGE RATES PER HOUR

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.25@1.40	$0.60@0.70	$0.60@1.00	$0.50	.....	$0.75@1.25	$0.25@.35
Baltimore	1.62½	1.00@1.10	1.00@1.37½	1.00	$0.65	1.00@1.25	.35
Birmingham	1.50	1.00	1.25	.50	.....	1.75	.25@.40
Boston	1.40	1.25	1.25	.79	1.15	1.37½	.45@.74
Cincinnati	1.50	1.37½	1.37½	.92½	1.37½	1.37½	.45@.60
Chicago	1.62½	1.50	1.00@1.50	.90@.96¼	1.50	1.50	.90
Cleveland	1.62½	1.37½	1.37½	.87½	1.10	1.50	.87½
Dallas	1.67½	1.12½	1.25	.40@.75	1.25	1.25	.35@.50
Denver	1.50@1.62½	1.25	1.25@1.37½	.87½@1.00	.....	1.25	.50@.62½
Detroit	1.56¼	1.00@1.25	1.00@1.10	.90	1.00@1.10	1.00@1.25	.50@.60
Kansas City	1.50	1.25	1.25	.90	1.25	1.25	.35@.75
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.50
Minneapolis	1.25@1.37½	.87½@.95	.87½	.75	.....	1.00	.45@.60
Montreal	1.12	.75	.75	.40	.50	.80@1.00	.30@.35
New Orleans	1.50	.90	1.25	.75	.80@1.00	1.25	.30@.40
New York	1.75	1.50	1.75	1.12½	1.00@1.12½	1.75	.90½
Philadelphia	1.62½	1.12½@1.25	1.02½	.70@1.12½	1.00	1.37½@1.50	.45@.75
Pittsburgh	1.70	1.50	1.43¾@1.56¼	1.12½	.....	1.50	.40@.80
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.25	1.50	.45@.75
San Francisco	1.37½	1.12½	1.00@1.12½	.87½	1.12½	1.37½	.50@.60
Seattle	1.50	1.12½	1.25	1.00	1.12½	1.25	.70

of $2 per day, and carpenters a decrease of $1, with the hope of stimulating local building. Present wages, therefore, are $9 for bricklayers and plasterers, and $7 for carpenters.

Structural ironworkers' wages in Boston were advanced 12½c. per hour to $1.37½. Further changes are expected to come in other trades before Sept. 1.

Carpenters of Buffalo have reached an agreement with employers to continue the present scale until Oct. 1, at which time an advance of 50c. per day will go into effect.

Striking ironworkers of Toronto returned after a dispute lasting nearly two months. The men have resumed work at the old rate of 90c., against demands for $1 and union recognition.

The two building trades councils which formerly existed in New York City united July 1 to form one union of 150,000 members.

Hodcarriers and laborers of Bridgeport returned after a strike lasting two weeks. Their demand for higher wages will be arbitrated.

Employment in the construction industry continues to show unevenness.

Higher Steel Cost Foreseen; Other Materials Steady

Prices of the principal building materials taken as a group show little change from last month's levels, with the tendency slightly upward. Except for cement and steel, current quotations are below a year ago, although demand is 5 per cent greater.

Steel prices tend upward. The principal makers are charging $1.90 to $2 per 100 lb. Pittsburgh, on large lots, for fourth quarter delivery. Present sales, however, are usually at $1.85, the same price that prevailed throughout July. A year ago steel was selling at $1.80.

An exceptionally active midsummer steel market is being supported mainly by demand for shapes, reinforcing bars, pipe, automotive and agricultural implement material. Buying of freight car material, on the other hand, is unusually light. Both production and demand are increasing. Structural steel sales of 1,586,250 tons for the first six months of this year are 13.6 per cent heavier than for the corresponding period of 1927; ingot output of 24,792,885 tons is 3.7 per cent greater than for the corresponding period of 1927.

Lumber prices have increased steadily and generally since early spring. The movement at this time last year was sharply downward for both softwood and hardwood. The long-term trend in all species is down. Cutting of softwood at the rate of 300,000,000 ft. a week is safely ahead of sales. Yard stocks are below normal.

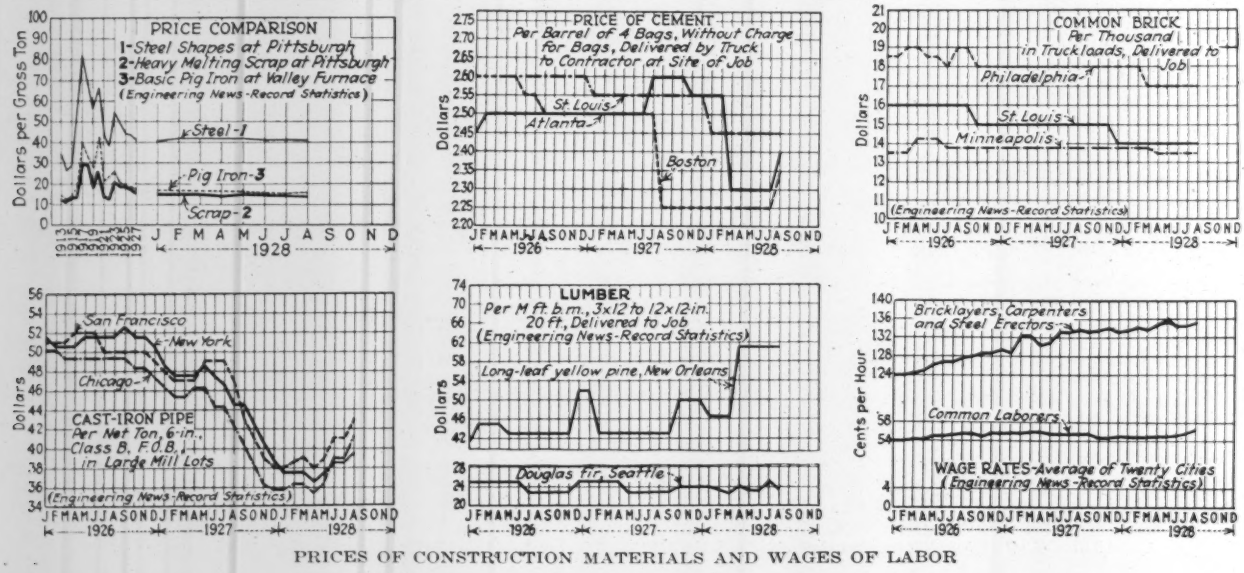
Cement prices are steady. Mills are producing 17,000,000 bbl. per month, the same rate as at this time last year. Shipments to dealers, a million barrels a month ahead of production, thus reducing mill stocks, which are lighter than at any time since last January.

Brick prices are not expected to change this summer. Unfilled orders at yards are well ahead of shipments, with new orders 15 per cent smaller than at this time last year. The manufacturers report that brick demand for churches, schools, hospitals and other institutional buildings is ahead of last year. In Chicago, Detroit, Cleveland, New York and several other cities the call for brick in small residences is 15 to 25 per cent under that of a year ago.

Continued heavy demand for building materials is foreseen in reports of railroads on freight car requirements. An increase over the third quarter last year is predicted by all regional advisory boards except those of the Ohio Valley and the Central West.

The most important price advances are as follows: Cast-iron pipe, now at peak demand, $1 per ton at Birmingham mill; asphalt, 50c. per ton at Boston; asphalt felt, 25c. per 100 lb. at New York; the majority of lumber price changes are up.

Declines were as follows: Heavy melting steel, scrap, to New York dealers, 50c. per ton; black steel sheets, 5c.; and galvanized, 10c. per 100 lb., Pittsburgh mill; lime, 25c. per ton at Denver; linseed oil, 0.4c. per pound at Minneapolis, following the recent decline in the flaxseed market.



PRICES OF CONSTRUCTION MATERIALS AND WAGES OF LABOR

E. N.-R. Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southerr (silicon 2.25@2.75)	$19.69
Northern Basic	20.89
No. 2 Southern Ohio (silicon 1.75@2.25)	21.19
NEW YORK, tidewater delivery	
Southern No. 2 (silicon 2.25@2.75)	25.62
BIRMINGHAM	
No. 2 Foundry (silicon 2.25@2.75)	16.00
PHILADELPHIA	
Eastern Pa., No. 2X (silicon 2.25@2.75)	*20.76*
Virginia No. 2 (silicon 2.25@2.75)	27.17
Basic	*19.76*
CHICAGO	
No. 2 Foundry Local (silicon 1.75@2.25)	20.00
No. 2 Foundry Southern (silicon 2.25@2.75)	22.01
PITTSBURGH, including freight charge ($1.76) from the Valley	
No. 2 Foundry Valley (silicon 1.75@2.25)	*19.26*
Basic	19.26
Bessemer	21.26

SCRAP—The prices following are f.o.b. per ton paid by dealers:

	New York Per Gross Ton	Chicago Per Gross Ton	Birmingham Per Gross Ton
No. 1 railroad wrought	*$9.00*@ $9.50	$12.00@$13.00	$11.00@$11.50
Stove plate	*8.25*@ *8.75**	13.00@13.50	9.00@ 9.50
No. 1 machinery cast	12.50@ 14.00	15.00@15.50	12.50@ 14.00
Machine shop turnings	6.00@ 6.50	*6.50*@ *7.00*	7.00@ 7.25
Cast borings	6.00@ 6.50	9.00@ 9.50	7.25@ 7.50
Railroad malleable	10.00	12.50@ 13.00	10.25@ 10.75
Re-rolling rails	10.00@ 10.50	**14.50**@ **15.00**	10.25@ 10.75
Re-laying rails, 56@60 lb.	23.00@ 24.00	23.00@ 25.00	23.00@ 24.00
Heavy melting steel, No. 1	*9.00*@ 9.85	12.50@ 13.00	9.50@ 10.00
Iron and steel pipe	8.25@ **8.75**	.....	8.50

Railway Supplies

STEEL RAILS—Per gross ton f.o.b. for large mill lots:

	Pittsburgh	Birmingham	Chicago
Standard bessemer rails	$43.00	$43.00	$43.00
Standard openhearth rails	43.00	43.00	43.00
Light rails, 25 to 45 lb.	36.00	34@36	36@38
Re-rolled rails	30@**32**	34@36	.....

RAILWAY TIES—For fair-sized orders, f. o. b., the following prices per tie hold:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
New York	Long-leaf sap pine, untreated	$1.10	$1.30
	Creosoted—prices on application.		
Birmingham	Southern pine untreated	1.10	1.25
	Southern pine, creosoted	1.60	1.75
St. Louis	White oak, untreated	1.20	1.80
	Red oak, creosoted	1.50	2.30
	Sap pine or cypress, untreated	1.00	1.60
Chicago	White oak, heart, untreated	1.40	1.78
	Oak, empty cell, creosoted	1.80	2.40
	Oak, zinc treated	1.60	2.10
	Southernpine, creosoted	1.60	2.10
San Francisco	Douglas fir, green, untreated	.82	1.14
	Douglas fir, empty cell, creosoted	1.73	2.32

TRACK SUPPLIES—Per 100 lb. f.o.b. Pittsburgh mill for large mill lots together with warehouse prices at other places named:

	Pittsburgh	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.80	$3.55	$3.65	$3.85	$3.00
Track bolts	3.80	4.55	4.65	5.35	3.90
Standard section angle bars, splice bars or fish plates	2.75	3.40	4.25	4.25	3.00
Tie plates	2.15	2.15*	2.58	.....	.....

*At Chicago mills in carloads.

Pipe

WROUGHT STEEL AND IRON PIPE—The following discounts from list are for large mill lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT-STEEL PIPE—On deliveries from warehouses at the places named the following discounts from list hold for standard steel pipe:

	Black			Galvanized		
	New York	Chicago	St. Louis	New York	Chicago	St. Louis
1 to 3 in. butt welded	50%	54%	49%	36%	41%	36%
2½ to 6 in. lap welded	45%	51%	46%	32%	38%	33%

WROUGHT STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches External	Diameter in Inches Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28
7	2.38	7.625	7.023	.301
8	2.50	8.625	8.071	.277
8	2.88	8.625	7.981	.322
9	3.45	9.625	8.941	.342
10	3.20	10.750	10.192	.279
10	3.50	10.750	10.136	.307
10	4.12	10.750	10.020	.365
11	4.63	11.750	11.000	.375
12	4.50	12.750	12.090	.330
12	5.07	12.750	12.000	.375

CAST-IRON PIPE—Prices per net ton for bell and spigot pipe, Class B and heavier, f. o b., in large mill lots:

	Birmingham	Burlington, N. J.	New York
4 in.	**$37.00**	$40.00	$42.60
6 in. and over	**34.00**	37.00	39.60

	Pittsburgh	Chicago	St. Louis	San Francisco
4 in.	**$45.50**	$45.20@**$46.20**	**$42.60**	**$47.00**
6 in. and over	**42.50**	42.20@**43.20**	**39.60**	**44.00**

Gas pipe and Class "A," $3.00 per ton extra.

CLAY DRAIN TILE—Prices are delivered per 1,000 lin.ft.:

Size, In.	New York	St. Louis	Birmingham	San Francisco	Dallas
3	$45.00	$50.00	$45.00	.....	.....
4	56.00	50.00	56.00	$67.50	$73.00
5	.....	85.00	80.00	86.25	110.00
6	90.00	85.00	105.00	112.50	118.00
8	150.00	195.00	175.00	175.00	150.00

SEWER PIPE—Prices are delivered in cents per foot for standard pipe; 6, 8 and 12-in. single strength and 18, 24, 30 and 36-in. double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.20	$0.26½	$0.44½	.....	$1.70	.....	.....
Baltimore	.16	.24	.46	.....	1.53	.....	$6.59
Birmingham	.135	.2215	.4015	$1.4625	2.665	$3.90	5.06
Boston	.15	.27	.51	1.20	1.85	3.00	5.50
Cincinnati	.135	.21	.405	.75	1.35	2.16	4.8175
Chicago	.16	.28	.54	1.25	2.25	.....	.....
Dallas	.256	.42	.794	1.70	3.00	.....	.....
Denver (f.o.b.)	*.161*	*.23*	*.41½*	*.816*	*1.44*	.....	.....
Detroit	.18	.28	.6075	1.50	2.70	.....	.....
Kansas City	.21	.29	.52	.....	1.90	3.80	.....
Los Angeles	.21	.27	.486	.....	1.74	.....	.....
Montreal	.....	.45	.75	.....	2.60	.....	.....
Minneapolis (f.o.b.)	.1575	.25	.45	.85	1.80	3.75	4.94
New Orleans	.195	.325	.5525	1.105	2.112	.....	.....
New York	.20	.32	.61	1.50	2.70	5.12	7.91
Philadelphia (f.o.b.)	.117	.182	.351	1.025	**1.845**	**3.60**	**5.6375**
Pittsburgh (f.o.b.)	.0945	.147	.2835	.90	1.62	3.024	4.8175
St. Louis	.1645	.26	.468	1.092	1.872	3.65	4.80
San Francisco	.21	.30	.54	1.32	2.16	3.60	.....
Seattle	**.22**	**.30**	.54	1.26	2.16	3.60	.....

Road and Paving Materials

ROAD OILS—Price per gal. in tank cars, 8,000 gal. minimum, f.o.b., at places named:

New York, 40@50% asphalt	(at terminal)	*$0.0625* @$0.075
New York, 50@60% asphalt	(at terminal)	*.0625* @ .072
St. Louis, 40@50% asphalt		.0418
St. Louis, 50@60% asphalt		.0407
Birmingham, 40@50% asphalt		.0525
Birmingham, 50@60% asphalt		.0475
Dallas, 40@50% asphalt		.061
Dallas, 50@60% asphalt		.06

E. N.-R. Prices of Construction Materials

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (Texas)	$24.50	$16.50
Boston (Mexican)	**24.50**	19.00
Chicago (Texas)	24.50	21.30
San Francisco, (f.o.b. refinery, Oleum, Calif.)	18.00	12.00
Dallas (Texas)	26.00	.....
Seattle, ("D" grade, California, f.o.b Richmond refinery)	19.50	13.50
Denver (California)	35.00	.....
Minneapolis, (Stanolind, f.o.b. Twin Cities)	28.10	22.10
St. Louis (Mexican)	23.50	19.50
Baltimore (Standard Oil, f.o.b. refinery)	21.75	17.75
Montreal (Imperial)	28.00	21.50
Atlanta (Mexican)	22.60	18.40
Detroit (Mexican)	24.00	19.00
Cincinnati (Kentucky Rock)	.....	11.65
Maurer, N. J. (Bermudez)	30.00	.....
Maurer, N. J. (Trinidad)	23.00	.....
Philadelphia (Mexican)	20.00	18.00
Kansas City, Mo. (Texas)	27.00	25.00
Los Angeles ("D" Grade, California, f.o.b. El Segundo)	18.00	12.00
Birmingham (Mexican)	27.00	21.00
New Orleans (Mexican)	20.00	17.00

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton. Drums used in New York.

PAVING STONE—Prices, f.o.b., in carloads or cargo lots for 5-in. granite blocks:

New York, Grade 1, 30 blocks per sq.yd	$150.00 per M.
San Francisco, Basalt block, 4x7x8	70.00 per M.
Chicago	3.25@3.60 per sq.yd.
Boston	135.00 per M.
Atlanta	2.50 per sq.yd.
Detroit	3.00 per sq.yd.
Baltimore	3.00 per sq.yd.
Montreal	104.75 per M.
New Orleans, 4x8x4	2.75 per sq.yd.
Cincinnati	110.00 per M.
St. Louis	3.30@3.40 per sq.yd.
Kansas City	3.50 per sq.yd.
Philadelphia	3.90@4.25 per sq.yd.
Minneapolis, Sandstone	2.74 per sq.yd.

FLAGGING—Prices in fair-sized quantities, alongside dock:

New York	Bronx, 4 ft. wide	$0.24 per sq.ft.
	Manhattan, 4 ft. wide	.24 per sq.ft.
	Queens, 5 ft. wide	.26 per sq.ft.
	6x24-in. cross-walk	1.30 per lin.ft.

CURBING—*New York*: Bluestone, f.o.b. barge, New York, 5x16 in., rough, 90c. per lin.ft., cutting charges extra.

St Louis: Class "B" straight, delivered, 5x16 in., 80c. per lin.ft.; roundings, $1.15 per lin.ft.

Birmingham: Limestone, 5x18-in., f.o.b., $1.05 per lin.ft.

WOOD-BLOCK PAVING—Prices f.o.b. in carloads:

	Size of Block	Treatment	Per Sq.Yd.
New York	3	16	$2.40
New York	3½	16	2.70
Boston	3½	18	2.40
Boston	4	18	2.75
Chicago	3½	16	2.10
Chicago	4	16	2.25
St. Louis	3½	16	2.20
St. Louis	4	16	2.50
Minneapolis	3½	16	2.50
Atlanta	3½	16	2.00
New Orleans	3½	16	2.30
New Orleans	4	16	2.40
Dallas	4	18	3.90
Montreal	4	16	4.50
Detroit	3½	16	1.94
Cincinnati	3½	16	2.35
Kansas City	3½	16	3.85

Construction Materials

SAND AND GRAVEL—Prices are per cu.yd. delivered. Weight of sand, 1½ tons per cu.yd.; gravel, 1½ tons per cu.yd. unless otherwise specified in pounds.

	Gravel		Sand
	1½ In.	¾ In.	
New York	$3.25@$3.50	$3.25@$3.50	$2.00@$2.25
Denver (2,700)	1.80	1.80	1.30
Chicago	2.10@2.25	2.10@2.25	2.10@2.25
St. Louis, per ton	2.30	2.30	1.90@2.30
Seattle (3,200) (2,850)	1.00	1.00	1.00
Dallas	2.50	2.50	2.25@3.00
Minneapolis (2,800)	2.25 ton	2.25 ton	1.00
Cincinnati, per ton	1.90	1.60	1.60
San Francisco (bunkers) (2,800)	1.80	1.80	1.40
Boston, per ton	1.90	1.90	1.35
New Orleans (2,700) (2,500)	**2.75**	**2.75**	**1.75**
Los Angeles, per ton	2.30	2.30	1.60
Atlanta, per ton	3.00	3.00	2.25
Detroit (2,600)	3.00	3.00	2.50
Baltimore, per ton	2.40	**2.75**	1.70
Montreal, per ton	1.90	1.50	1.20
Birmingham (2,600)	3.00	3.00	2.65
Philadelphia, per ton	2.05@2.90	2.05@2.90	1.40@2.25
Kansas City, Mo.	2.40	2.40	.70 ton at pit
Pittsburgh, per ton, f.o.b	.85	1.05	1.25

Note: New York gravel weighs 2,800@3,000 lb. and sand, 2,700 lb.

CRUSHED STONE—Prices are per cu.yd. delivered. Weight 1½ tons per cu. yd., unless otherwise specified in pounds:

	1½ In.	¾ In.
New York, Limestone	$3.25@3.50	$3.25@3.50
Chicago, Limestone	2.10@2.25	2.10@2.25
St. Louis, per ton	2.30	2.30
Dallas	3.25	3.40
San Francisco, Trap rock, bunkers (2,400)	1.70	1.70
Boston, per ton	2.25	2.25
Minneapolis, Limestone, per ton	2.25	2.25
Kansas City, Limestone, per ton, (2,450)	**2.50**	**2.50**
Denver, Granite (2,700)	2.50	2.50
Seattle, (2,700)	1.90	1.90
Atlanta, per ton	3.00	3.00
Cincinnati, per ton	2.25	2.25
Los Angeles, per ton	2.30	2.30
Detroit, Limestone, per ton	2.50	2.60
Baltimore, per ton	2.75	2.85
Montreal, per ton	.....	2.10
Philadelphia, Limestone, per ton	2.30@3.15	2.30@3.15
Pittsburgh, per ton	2.75	2.75
Cleveland, per ton	3.00	3.00
Birmingham, Limestone	2.50	2.50

CRUSHED SLAG—Price of crushed slag in carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Buffalo District	1.25	1.35	2.25	1.25
Birmingham, Ala	.90	1.25	2.05	.80
Cleveland, Ohio	1.20	1.20	.....	1.30
Eastern Pa. and Northern N. J.	1.25	1.25	2.00	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	....	1.25

LIME—Prices delivered to job:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$21.00@22.00	$14.00@15.00	$4.00@4.10*	$3.15@3.25*
Chicago	20.00	18.00	.....	1.50†
St. Louis	24.00	18.00	2.50†	15.00‡
Boston	20.00	14.00	3.85*	3.00*
Dallas	20.00	.....	.....	18.00‡
Cincinnati	16.80	13.20	.....	13.20‡
San Francisco	27.50	*20.00*	.....	1.70†
Minneapolis	25.50	21.00	.....	1.70†
Denver	32.00	*23.75*	3.80*	3.00*
Detroit	19.20	14.80	2.20†	2.20†
Seattle, paper sacks	24.00	.....	.....	2.80*
Los Angeles	26.00	18.00	2.40†	19.00‡
Baltimore	20.00	14.00	2.55†	.....
Montreal	21.00	21.00	.....	15.00‡
Atlanta	**24.50**	15.00	2.30†	2.10†
New Orleans	.....	.....	.....	2.00†
Philadelphia	22.00	15.00	.....	.....
Kansas City	.....	.....	2.62†	2.10†
Birmingham	22.00	16.00	2.40†	1.85†
Pittsburgh	22.00	18.00	.....	.....

*Per 280-lb. bbl. (net). †Per 180-lb. (net). ‡Per ton.

NATURAL CEMENT—Prices per bbl. delivered to contractors, without charge for bags:

Kansas City, Ft. Scott	**$2.00**
Cincinnati, Utica	1.72
St. Louis, Carney	2.25
Birmingham, Magnolia pozzolan cement	2.60

PORTLAND CEMENT—Prices per bbl. delivered to contractors, in carloads, *without charge for bags.* Cash discount not deducted.

	Aug. 2, 1928	One Month Ago	One Year Ago
New York	$2.25@$2.35	$2.25@$2.35	$2.35
Jersey City	2.35	2.35	2.13f.o.b.
Boston	2.35	2.35	2.05f.o.b.
Chicago (f. o. b.)	2.05	2.05	2.05
Pittsburgh (f. o. b.)	2.04	2.04	2.04
Cleveland (f. o. b.)	2.24	2.24	2.24
Detroit (f. o. b.)	1.90	1.90	2.15
Indianapolis, (f. o. b.)	2.19	2.19	2.19
Milwaukee (f. o. b.)	2.20	2.20	2.20
Duluth (f. o. b.)	2.04	2.04	2.04
Peoria (f. o. b.)	2.22	2.22	2.22
Cedar Rapids (f. o. b.)	2.24	2.24	2.24
Davenport (f. o. b.)	2.24	2.24	2.24
St. Louis	2.45	2.45	2.05f.o.b.
San Francisco	2.41	2.41	2.51
New Orleans	2.20	2.40	2.50
Minneapolis (f. o. b.)	2.22	2.22	2.22
Denver	2.85	2.85	2.85
Seattle	2.70	2.70	2.65
Dallas	2.40	2.40	2.05f.o.b.
Atlanta	2.25	2.40	2.40
Cincinnati (f. o. b.)	2.22	2.22	2.32
Los Angeles	2.66	2.66	2.56
Baltimore	2.65	2.65	2.50
Birmingham	2.60	2.60	2.40
Kansas City, Mo.	2.40	2.30	2.07f.o.b.
Montreal (f. o. b.)	1.41	1.41	2.22
Philadelphia	2.31@2.41	2.31@2.41	2.40
St. Paul (f. o. b.)	2.22	2.22	2.22
Toledo (f. o. b.)	2.20	2.20	2.20

Current mill-prices per barrel, in carloads, without bags, f.o.b., to contractors:

Buffington, Ind.	$1.80	Richard City, Tenn.	$1.85
Universal, Pa.	1.80	North Birmingham, Ala.	1.45
Steelton, Minn.	1.85	Leeds, Ala.	1.65
Fordwick, Va.	2.05	Hannibal, Mo.	1.90
Mitchell, Ind.	1.90	Lehigh Valley District	1.75
Iola, Kan.	1.85	Wyandotte, Mich.	1.65
Mason City, Ia.	1.80	Alpena, Mich.	1.60
La Salle, Ill.	1.90	Kingsport, Tenn.	2.05
Hudson, N. Y.	1.75	Clinchfield, Ga.	1.65

E. N.-R. Prices of Construction Materials

WIRE REINFORCEMENT FOR CONCRETE—Price per 100 sq.ft. in carloads at mills; from warehouses per 100 sq.ft. in lots of 10,000 sq.ft. or over.

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse: New York*	St. Louis	Dallas	San Francisco
032	22	$0.99	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.26	1.29	1.76	1.35	1.38	1.55
068	35	1.54	1.58	2.18	1.66	1.67	1.91
093	45	1.98	2.03	2.79	2.13	2.00	2.46
126	57	2.45	2.51	3.45	2.63	2.55	3.03
153	68	2.92	2.99	4.13	3.14	3.15	....
180	78	3.35	3.43	4.73	3.60	3.47	....
245	103	4.43	4.53	6.24	4.75	4.58	....
287	119	5.12	5.24	7.20	5.50	5.26	....
336	138	5.93	6.07	8.36	6.37	6.11	....
395	160	6.88	7.04	9.68	7.38	7.12	....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher.
*Delivered to job. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

BARS, CONCRETE REINFORCING—Pittsburgh and Birmingham prices are for large mill lots, per 100 lb., f.o.b. mill. In other cities listed, prices are per 100 lb., for bars delivered from warehouse stocks.

ROLLED FROM BILLETS

Inches	Pittsburgh	Birmingham	Warehouse: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$1.95	$2.05	$3.25*	$2.30@2.75	$3.15	$3.75	$2.25
⅜	2.05	2.15	3.35*	2.40@2.85	3.25	3.95	2.35
¼	2.15	2.25	3.45*	2.50@2.95	3.35	3.95	2.45
⅝	2.35	2.45	3.65*	2.70@3.15	3.55	4.10	2.65
½	2.95	3.05	4.25*	3.30@3.75	4.15	4.75	3.25

For standard classification of extras for size and cutting of steel bars, see bar card of July 15, 1923. *250 to 3,999 lb.

EXPANDED METAL LATH—Per 100 sq.yd., painted, delivered to job in less-than-carload lots:

Weight in Pounds per Sq. Yd.	New York	Birmingham	Chicago	St. Louis	San-Francisco	Dallas
2.2	$19.00	*$19.00*	$16.00	$16.00	$18.50	*$20.06*
2.5	20.00	*20.00*	17.00	17.00	19.50	*21.50*
3.0	22.00	*22.50*	19.06	19.00	22.00	*24.50*
3.4	23.50	*24.50*	20.50	20.50	24.00	*27.00*

BRICK—Contractors price, delivered, per M, is as follows:

	Common	Paving: 3x8¼x4-in.	3¼x8¼x4-in
New York	$17@20	$45.00	$51.00
Chicago	12.00	42.00	45.00
St. Louis, salmon	14.00	40.00	42.50
Denver, salmon	12.00	.....	.....
Dallas	14.50	35.00	.....
San Francisco	13.00	.....	.....
Los Angeles	11.00	.....	.....
Boston	17.50	45.00	51.00
Minneapolis	13.50	.....	.....
Kansas City	14.00	.....	.....
Seattle	*14.50*	.....	55.00
Cincinnati	18.00	40.00	45.00
Montreal	20.33	.....	.....
Detroit	15.50	35.50	38.50
Baltimore	15.00	40.00	45.00
Atlanta	13.75	.....	.....
New Orleans	**16.00**	.....	.....
Birmingham	15.00	32.00	32.00*
Philadelphia	17.00	40.00	46.00
Pittsburgh	17.00	.....	.....
Cleveland	14@16	.....	.....

*2¼x9x4 in.

HOLLOW TILE—Price of hollow building tile per block delivered to contractors in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Boston	$0.0775	$0.10	$0.1385	$0.1750	$0.2375
Minneapolis	.0842	.....	.1476	.....	.2441
Cincinnati	.074	.....	.136	.....	.205
Kansas City	*.0535*	.....	.158	.....	.242
Denver	**.0975**	.135	**.175**	**.2125**	**.25**
Seattle	.10	.....	.18	.....	.26
Los Angeles	.085	.....	.172	.....	.285
New Orleans	.09	.....	.165	.....	.245
Detroit	.092	.127	.208	.256	.293
Montreal	.12	.....	.22	.....	.315
Baltimore	.085	.....	.175	.....	.232
Atlanta	.0808	.....	.1516	.....	.2232
Dallas	.0985	.1205	.1785	.284	.....
Birmingham	.09	.127	.174	.....	.....
Pittsburgh	.068	.....	.1175	.....	.1726
Cleveland	.06	.....	*.128*	.....	.....
New York	.0973	.1459	.1824	.2313	.3084
Chicago	.076	.104	.142	.182	.202
Philadelphia	.11	.145	.22	.27	.34
St. Louis	.078	.105	.145	.175	.210
San Francisco	.108	.156	.255	.....	.....
Perth Amboy, N. J. (f.o.b.)	.....	.....	.....	.252	.312

STRUCTURAL MATERIAL—Pittsburgh and Birmingham prices are for large mill lots, per 100 lb., f.o.b. mill. At other cities listed, quotations apply on less-than-carload lots delivered from warehouse stocks:

	Pittsburgh	Birmingham	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$1.85	$2.05	$3.30*	$3.50	$3.25	$3.10	$3.25
Channels, 3 to 15 in.	1.85	2.05	3.30*	3.50	3.25	3.10	3.25
Angles, 3 to 6 in., ¼ in. thick	1.85	2.05	3.30*	3.50	3.25	3.10	3.25
Tees, 3 in. and l'rg'r.	1.85	2.05	3.30*	3.50	3.25	3.10	3.25
Plates, ¼ in. thick and heavier	1.85	2.05	3.30*	3.50	3.25	3.10	3.25

*250 to 3,999 lb.

RIVETS—The following quotations are per 100 lb., full packages, delivered from warehouse:

ROUND-HEAD STRUCTURAL

	Pittsburgh Mill	Warehouse: New York	Chicago	St. Louis	San Francisco	Dallas
½ in.	$2.90	$5.00	$3.60	$3.75	$5.75	$5.00

CONE-HEAD BOILER

½ in.	$2.90	$5.00	$3.60	$3.75	$5.75	$5.00

NAILS—The following quotations are per 100 lb. keg delivered from warehouse stocks, also Pittsburgh mill base:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.55	3.10	$3.10	$3.60	$4.00	$2.75	$4.95
Cut	2.80	3.30	....	5.00	5.00	....	5.00

SHIP SPIKES—Current prices per 100 lb. delivered from warehouse:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
½	$7.55	$5.80	$7.75
⅝	6.85	5.10	5.65
¾	6.70	4.95	5.50

Pittsburgh base in lots of 200 kegs or more, $3.00 per 100 lb.

PREPARED ROOFINGS—Slate-surfaced roofing in rolls weighing 85 to 90 lb., costs $2.50 per square to contractors in carloads, f.o.b., New York.

Single shingles, slate finish, cost $6.12½ per square (sufficient to cover 100 sq.ft.) in carloads, f.o.b., New York.

Strip shingles (4 in 1) f.o.b. New York, in carloads to contractors, are $5.00 per square for the hexagonal shape, with Underwriters' label.

ROOFING MATERIALS—Prices f.o.b. New York, to contractors in carloads:

Tar felt per, 100 lb	$3.27½
Asphalt coating, per gal	.40
Asphalt felt, per 100 lb	**3.50**

WINDOW GLASS—United inches 25, bracket size 6x8 to 10x15, discount from jobbers' list (Mar. 1, 1913) at New York warehouses:

Single Thickness		Double Thickness	
AA	83%	AA	83%
A	88%	A	88%
B	89%	B	89%

SHEETS—Quotations are per 100 lb. in various cities delivered from warehouse stocks, also the base quotations at mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	**$2.00@$2.10**	$3.60	$3.50	**$3.90**	$3.90*
No. 12	**2.05@ 2.15**	3.65	3.55	**3.95**	3.95*
No. 14	**2.15@ 2.20**	3.70	3.60	**4.00**	4.00*
No. 16	**2.25@ 2.30**	3.80	3.70	4.10	4.10*
Black					
Nos. 18 to 20	*2.40 @ 2.45*	4.05	3.75	**4.80**	4.00
No. 22	*2.55 @ 2.60*	4.20	3.90	**4.95**	4.15
No. 24	*2.60 @ 2.65*	4.25	3.95	**5.00**	4.20
No. 26	*2.70 @ 2.75*	4.35	4.05	**5.10**	4.30
No. 28	*2.85 @ 2.90*	4.50	4.20	**5.25**	4.45
Galvanized					
No. 10	*2.70@2.85*	4.40	4.10	**4.70**	4.25
Nos. 12 to 14	*2.80@2.95*	4.50	4.20	**4.80**	4.35
No. 16	*2.90@3.05*	4.60	4.30	**5.00**	4.45
No. 18	*3.05@3.20*	4.75	4.45	**5.05**	4.60
No. 20	*3.20@3.35*	4.90	4.60	**5.20**	4.75
No. 22	*3.25@3.40*	4.95	4.65	**5.25**	4.80
No. 24	*3.40@3.55*	5.10	4.80	**5.40**	4.95
No. 26	*3.65@3.80*	5.35	5.05	**5.65**	5.20
No. 28	*3.90@4.05*	5.60	5.30	**5.90**	5.45

Extra for corrugated sheets, 15c. per 100 lb. *250 to 3,999 lb.

LINSEED OIL—These prices are for raw oil in barrels, f.o.b. in 1 to 4-bbl. lots:

	New York	Chicago	Minneapolis
Per pound	*$0.107*	*$0.108*	*$0.111*

E. N.-R. Prices of Construction Materials

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry	In Oil
Red	$13.25	$14.75
White	13.25	13.25

Lumber

Prices Are Per Thousand Feet, Board Measure

San Francisco—Prices of rough Douglas fir, No. 1 common, at yards; prices delivered to contractor at site of job, $1.50 to $5 per M. ft. additional:

	10-16-18 and 20 Ft.	22 and 24 Ft.
3x3 and 4	$28.00	$29.00
3x6 and 8	28.00	29.00
3x10 and 12	28.00	29.00
3x14	31.00	33.00

Chicago—Prices, f.o.b., in carloads, per M. ft. b.m.; prices delivered to job in truckloads from stock, $10 per M. ft. additional:

	20 Ft. and Under No. 1 Long-Leaf Yellow Pine	Up to 32 Ft. No. 1 Douglas Fir
3x4 to 8x8	*$37.50*	$41.50
3x10 to 10x10	46.50	41.50
3x12 to 12x12	56.50	41.50
3x14 to 14x14	.....	42.50
3x16 to 16x16	.....	44.50

New York—Prices per M. ft., b.m., wholesale, for rough, long-leaf, yellow-pine timbers in quantities of 35,000 ft. or more, within lighterage limits:

	20 Ft. and Under Long-Leaf Yellow Pine	22-24 Ft. Long-Leaf Yellow Pine
3x4 to 8x8	$41.00@$43.00	$42.00@$44.00
3x10 to 10x10	48.00@ 50.00	49.00@ 51.00
3x12 to 12x12	55.00@ 57.00	56.00@ 58.00
3x14 to 14x14	63.00@ 65.00	64.00@ 66.00
3x16 to 16x16	75.00@ 77.00	76.00@ 78.00

Other Cities—Prices delivered per M.ft., b.m.:

	8x8-In. x 20 Ft. and Under, Rough				3x12 to 12x12-In. 20 Ft. and Under, Rough	
	Pine*	Fir†	Hem-lock	Spruce	Pine*	Fir†
Boston	$48.00	$47.00	$47.50	$50.00	$56.25	$50.00
Seattle	.....	*23.00*	.....	.....	.....	*22.50*
New Orleans	40.00	56.00	.....	.....	61.00	55.00
Baltimore	36.00	50.25	54.00	**61.50**	75.00	50.50
Cincinnati	**36.00**	**49.00**	**47.00**	**47.00**	**40.00**	54.50
Montreal	50.00	55.00	.....	.....	49.00	48.00
Los Angeles	.....	**41.00**	.....	.....	.....	**41.00**
Denver	.....	**57.00**	.....	.....	.....	45.00
Minneapolis	53.00	48.25	36.25‡	.....	53@55	*48.25@49.75*
Atlanta	**45.00**	.....	.....	.....	**65.00**	.....
Dallas	57.50	57.50	.....	.....	57.50	57.50
Kansas City, Mo.	**40.50**	*38.75*	.....	.....	**53.50**	48.75
Birmingham	35.00	.....	.....	.....	*40.00*	.....
Philadelphia	55.00	37.00	42.00	43.00	65.00	50.50
Detroit	55.00	55.00	.....	.....	65.00	54.50
St. Louis	43.00	38.00	38.00	43.00	53.00	39.00

	1x10 In. x 16 Ft. and Under, Rough			2x10 In. x 16 Ft. T. & Gr.	
	Pine*	Fir†	Hem-lock	Pine*	Fir†
Boston	$43.50	$42.50	$44.00	$48.50	$47.50
Seattle	.....	*22.50*	.....	.....	*23.00*
New Orleans	36.00	.....	.....	44.00	.....
Baltimore	56.00	45.00	45.00	35.00	48.00
Cincinnati	**30.00**	**35.00**	**33.09**	**31.00**	**48.00**
Montreal	45.00	48.00	40.00	85.00	70.00
Los Angeles	.....	**35.00**	.....	.....	**50.00**
Denver	.....	**44.00**	31.25	.....	31.25
Minneapolis	48.00	42.00	35.75‡	48.00	43.00
Atlanta	40.00	.....	.....	**45.00**	.....
Dallas	.....	.....	.....	57.50	.....
Kansas City, Mo.	**59.00**	**44.25**	.....	**42.75**	36.75
Birmingham	36.00	.....	.....	48.00	.....
Philadelphia	**52.00**	36.50	36.00	**54.00**	36.50
Detroit	40.00	.....	.....	38.00	.....
St. Louis	43.00	.....	.....	31.00	.....

*Long-leaf yellow pine. †Douglas fir. ‡F.ob.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York:

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

Miscellaneous

STEEL SHEETPILING—The base price f.o.b. Pittsburgh for large mill lots is $2.25 per 100 lb.

CONCRETE BLOCKS—Standard, 8x8x16-in., delivered to job, each:

Denver	$0.22	St. Louis	*$0.18*
Detroit	.15	Boston	18@.20
New Orleans	.22	Minneapolis, f.o.b.	.14
Brooklyn and Queens	.16@.18	Philadelphia	18@.25
Pittsburgh	.18	Cleveland	17@.18

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized, are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope (add to list)	12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8-ft.; ⅝-in., 6-ft.; ¾-in., 4½-ft.; 1-in., 3½-ft.; 1¼-in., 2-ft. 10-in.; 1½-in., 2-ft. 4-in. Following are prices per pound for ¾-in. and larger delivered in 1,200-ft. coils:

Boston	$0.25	New Orleans	$.23½
New York	.24	Los Angeles	.25
Chicago	.21	Seattle	.21½
Minneapolis	.23	St. Louis	.21½
San Francisco	.21½	Montreal	.24½
Atlanta	.25	Detroit	.24½
Denver	.24	Baltimore	.22½
Cincinnati	.21	Kansas City	.25
Dallas	.21	Birmingham	35@.40
Philadelphia	*.245*	Cleveland	.30

EXPLOSIVES—Prices per pound for dynamite delivered in small lots:

	Gelatin 40%	Gelatin 60%
New York (Special gelatin in case lots.)	$0.26	$0.2825
Boston	.25	.275
Kansas City	.2025	.2225
Seattle	.16	.185
Chicago (Quantities above 500 lb., but less than a ton.)	.195	.22
Minneapolis	.1967	.2173
St. Louis	**.215**	**.24**
Denver (f.o.b.)	.1925	.215
Dallas	.2325	.2525
Los Angeles (f.o.b. San Fernando Arsenal)	.1875	.2225
Atlanta	.22	.245
Baltimore	.215	.2375
Cincinnati	.22	.245
Montreal	.195	.22
Birmingham (f.o.b.)	.155	.185
New Orleans	.235	.26
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, round lots in the New York market:

Sulphate of aluminum, iron free, in bags, per 100 lb.	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb.	5.30@ 5.50
Soda ash, 58%, in bags, per 100 lb.	1.32@ 1.35
Chlorine, liquid, cylinders, per lb.	.05½@ .08
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	2.00@2.10*

*F.o.b. works.

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carload lots of 36,000 lb. or 18 tons:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.735
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.29	St. Louis	.43
Cleveland	.19	St. Paul	.60
Denver	1.15*		

* Minimum carload for structural steel, 50,000 lb.; for other iron or steel products, 80,000 lb.